

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LONDON, LONDON

Telephone Number :
WHITEHALL 5891

No. 3544

SATURDAY, OCTOBER 2, 1937

Vol. 140

310497



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Scientific Aspects of Industrial Accidents

THE annual report of the Chief Inspector of Factories and Workshops for the year 1936 (Cmd. 5514. H.M. Stationery Office, 1937. 2s. net), raises several questions with which scientific workers are concerned, whether actually engaged in industries or as citizens interested in the protection of national health from conditions which would degrade it. Anyone reading the report would be disturbed at what is revealed in it as to the very long hours that are being worked in some of the newer industries. While in the nineteenth century, broadly speaking, Great Britain undoubtedly led the world in imposing limitations on hours of work and the observance of minimum standards of safety and health in factories and workshops, in the last few decades it is clear that the country has fallen sadly behind other important industrial countries in these matters.

The report shows that although the 47 or 48 hour week is considered normal, many cases are reported where the working week exceeds 48 hours, not only for busy periods but often also continuing for months at a time or even for most of the year. Work up to 50 and even 60 hours a week has been common in laundries, the metal trades in the Midlands, as well as in leather, bakelite and other industries and in the woollen and worsted trades, and some disconcerting examples of illegal employment of women and juveniles are cited in the report. Despite the improvement in the employment situation, unemployment is still far too severe and widespread for this situation to be regarded with equanimity. Obviously the inspectorate requires very much stronger and clearly expressed support from public opinion if even the minimum standards required by the law are to be enforced

and these abuses suppressed, nor can we feel confident that the advance represented by the provisions of the new Factories Act now passed will effect any improvement unless there is a very considerable increase in the inspectorate.

A significant share of that support may well be looked for from scientific workers, whether engaged in industrial work or not. Apart altogether from the posts of responsibility in the management of industry which many of them hold, they should not require this report to realize the connexion between long hours of work and industrial accidents and sickness, which is once again so clearly portrayed in its pages. On this subject parts of the report are painful reading. A substantial increase in accidents over the previous year is again recorded—about 15 per cent for accidents generally and 9 per cent for fatalities. Although the analysis and graphs submitted by the chief inspector afford some evidence that the risk of accident is tending to decrease, through such factors as the work of the inspectorate, the educational work of the National Safety Association, the Industrial Welfare Society and similar organizations, the closer supervision of the growing number of factory safety organizations, and especially through the growing recognition of their responsibility in this matter by employers, disturbing fluctuations in the risk of accident as well as in the numbers of accidents still occur from year to year.

Some of the causes of these fluctuations are obvious. The longer hours to which reference has already been made are a significant factor. The greater speed of production, the absorption of more inexperienced or unpractised workers, both old and young, and the installation of new plant

and machinery with unknown risks, are among other factors which are responsible for the rising toll of death and injury, and appear at present to be associated with increased production and prosperity.

That this position should be accepted as inevitable may well be challenged. Already there are many firms, both large and small, in which the safety of the worker is a first consideration, and where no new machinery or process is put into operation without every possible measure being taken to ensure that it is as safe as it is eventually intended to be. It should not be too difficult a task for professional associations and safety organizations to arouse public opinion in such matters to a point which would ensure not merely that the minimum requirements of the law were rigorously enforced, with adequate penalties if need be, but also that a high incidence of avoidable accidents, especially among the young workers, would be regarded as a definite slur on the reputation both of the firm and of its management.

The position of the juvenile worker requires special stress because of the exceptionally high accident rates among workers under eighteen years of age to which the report again directs attention, and also because of the possibilities of a much more rapid reduction in this accident rate among juvenile workers than among adults in the same occupation. While accidents to young workers are usually of the less serious kinds, the situation was regarded as sufficiently important to receive special attention from the inspectorate, and a separate chapter of the present report deals with accidents to young workers and methods of preventing them. In relation to young workers the question of industrial safety presents its own problems, and too often it appears beyond doubt that the special protection which should be accorded to young workers is wanting.

An attempt to apportion responsibility between the employer and the victim indicates that in only 23.8 per cent of the accidents to boys could no blame be attached. In 32.3 per cent of the accidents the firm was mainly responsible and in 44.3 per cent the boy. The figures for girls do not differ greatly, but in 51.1 per cent of the accidents the girl was mainly responsible. The inquiry also emphasized the greater liability to accident in the initial stages of employment; about 10.4 per cent of the boys and 24.4 per cent of the girls who were injured in the first six months being injured during the first week.

These figures alone emphasize the significant part which a sense of responsibility on the part of the management, combined with active oversight, can play in determining the standard of safety in a works, and they stress, too, the importance of educating the young worker in the risks attached to his work as well as the importance of selecting that work, and adequate supervision and training in the initial period of employment. In spite, however, of the attention directed to this matter as a result of a memorandum issued following a conference convened by the Home Office, in which the National Confederation of Employers' Organizations participated, the general progress has been unsatisfactory. The publicity given to the matter has as yet aroused little, if any, interest in many employers, and others have had no knowledge of it.

A large proportion of the accidents to juveniles appear to occur in the smaller factories, where only individual approach is likely to be effective, and the chief difficulty lies here rather than in the larger and better organized factories. Whether the factory is large or small, however, the interest of the occupier, managers and foremen is indispensable before there can be much hope of a noticeable reduction in these accidents.

For this reason, the interest and co-operation of the scientific worker in this matter is of prime importance. Whether or no he occupies a position on the management side, an experienced chemist or engineer, for example, is usually able to initiate steps leading to improved working conditions and to secure the formulation and observance of strict safety rules. He has also an indispensable contribution to make on the technical side in improved design or safer operating methods and conditions in new or established processes. His personal interest may largely determine the success or failure of attempts at educating the young recruit or in securing that the training and supervision he receives is efficient and not perfunctory.

Nor is this the only contribution which scientific workers can make in the field of industrial safety and accident prevention. Besides the enthusiastic and skilled leadership and co-operation of the man of science, whether in a technical or an administrative capacity, there is needed an alert and informed public opinion which will not tolerate the continuance of the abuses revealed in this report. Ridiculously inadequate penalties are at present inflicted for such exploitations of health and safety as the employment of boys of fourteen to

seventeen years of age for as many as eighty hours a week, of girls of fourteen from fourteen to fifteen hours a day, and women for an unbroken twenty days work, which are in themselves an obvious cause of industrial ill-health and accidents. Clearly the strong pressure of public opinion is urgently needed to stir some magistrates to a sense of responsibility in this matter, and a Government which professes so great an enthusiasm for physical health and training might do well to convey a strong hint to the offending quarters to discourage lenity as ill-timed as it is reprehensible.

This problem of arousing a public opinion will secure the observance not so much of the minimum standards of the law but rather of the practice of the more progressive firms, whether large or small, and supply the support which such firms, no less than the factory inspectors, themselves require, is less a matter for an individual scientific worker than for his professional associations. They indeed can afford the individual worker the

moral support he may need in making his stand against specific negligence or abuses which he may encounter in his ordinary industrial life, as well as supplying the stimulus and vision which may induce him to initiate constructive measures whether in the technical or more general sphere. Equally they could, if they chose to speak with a united voice and authority, mould public opinion and bring to an end the neglect and indifference which are as detrimental to industrial efficiency as to the health and well-being of the whole nation, and not only that of the individual workers, young and old, of whose lives and happiness so distressing a toll is now taken. The present report may well stir such professional associations as the British Association of Chemists and the Institute of Chemistry to take a more active part in creating an informed public opinion and in strengthening the hands of their members, especially when employed in professional isolation in the small firms where improvement is most needed.

National Factors of Physical Fitness

National Fitness :

The First Steps. (Issued by the National Advisory Council and the Grants Committee for Physical Training and Recreation.) Pp. 24. (London : H.M. Stationery Office, 1937.) 2d. net.

Physical Education in Germany

(Board of Education : Educational Pamphlets, No. 109.) Pp. 80. (London : H.M. Stationery Office, 1937.) 1s. net.

ON Tuesday, July 20, a striking leader appeared in *The Times*, entitled "The Empty Chair". It referred to the fact that physical culture had no conspicuous place among the subjects to be discussed at the annual meeting of the British Medical Association at Belfast. "If the doctors will not fill the empty chair, others less well qualified than they will fill it". "Into this pageant of life in action the science of nourishment and the science of personal hygiene will fit easily and with propriety. . . . This is the larger physiology. . . ." The complaint is just and timely. Physical training is largely neglected by doctors and physiologists in Great Britain, and it is almost impossible to obtain expert scientific advice on it.

The Physical Training and Recreation Act passed through Parliament this year. The little

pamphlet "National Fitness" shows how the National Advisory Council and the Grants Committee are beginning to plan the organization by which the Act may achieve its ends. It is curious that Great Britain—the home of 'sport'—is so backward in matters relating to the physical education (in its widest sense) of the people. How many of its towns have running tracks, gymnasia, swimming baths? How many of its schools and universities have means and personnel for the physical examination and assessment of their students? How many of our young people, lacking advice and encouragement, know anything of the joys of bicycling, tramping, camping (and singing) about the countryside? How many more than at present, even without help and leadership, might find out for themselves, in their holidays and week-ends, were the Youth Hostels multiplied ten times in number and capacity? How much health, happiness and content might result were there reasonable means of physical recreation, with organization, leadership and advice, within the reach of all instead of a small fraction of our people?

The beginning of a national effort is being made. Its success will depend on various factors : first, on public opinion, which, as the pamphlet truly says, "in this country means the opinion of the

people". It will be a sad thing for democracy if "the opinion of the people" in this matter of health and happiness continues to lag behind the accepted teaching of dictatorship. Secondly, on the provision of teachers and leaders: here again democracy has proved lamentably slow, but the pamphlet promises that "a new National College is being established". Will people of sufficient character, intelligence and enthusiasm come to be trained? And will there be assured careers for those who come? Thirdly, on the provision of financial and material means: the funds available to the Grants Committee are not small, but will they be sufficient? This is, or ought to be, a big business. Fourthly, on expert scientific advice on the physiological, medical, nutritional and psychological aspects of a many-sided problem. Such expert advice implies, not mainly consultation in committee (though that is necessary), but chiefly the handling of human beings: it requires, on one hand, something analogous to the clinical experience, the aptitude and sympathy of the good physician, on the other a trained capacity for making correct assessments and drawing accurate conclusions from human data. The "empty chair" will remain empty, or will be filled—as *The Times* said—by someone less well qualified, unless physiologists, medical men, experts in nutrition and psychology, realize that the production of health and fitness is at least as important as the treatment of disease.

The other pamphlet is the "report of a delegation who visited Germany in November last to investigate Physical Training there". It will be deplorable if a great and generous achievement, from which Great Britain might learn much, is disregarded or depreciated because of the indignation which many of the manifestations of national socialism have rightly evoked here, or because of some of the exaggerations and excesses of the achievement itself. The Hitler-Youth, with its six million (most of them) eager youngsters, is admittedly political: that, as the report points out, is—no doubt unfortunately—the German habit in physical education: and it has many aspects which, from the British point of view, are odd or objectionable. It takes children unduly from their homes; it sometimes injures them by over-exertion; although nominally voluntary "he is a rash lad who ventures to say that he proposes to stay out of it". It encourages its children to read some queer literature. Its potential military value, also, may be enormous; but so indeed is that of any group, sufficiently large, of happy, healthy people, disciplined in outdoor sports and activities, inured to hardship, bound by common loyalties. The fact that healthy loyal youngsters may make better and more ready soldiers is no

reason why unhealthy, cramped and discontented ones should make a better population.

The truth is, whether we like it or not, and as a comparison of these pamphlets shows, that, in its encouragement to youth (and middle age) to find happiness and recreation in the open air, and to develop health, skill, stamina, strength and self-respect by games and bodily exertion, Germany has gone very far beyond Great Britain. In some respects it has gone too far, but that may be repaired as experience is gained. The achievement is not due only to enthusiasm and devotion. In the "Napoli" schools "the doctor is a most important member of the staff". Research in physical education "is beginning to be of interest to the biologists in the universities". The National Physical Training Academy offers "facilities which are far beyond those which any institution in this country can provide". The training of teachers in physical education, and of leaders in sport, gymnastics and outdoor recreations (teachers and leaders of either sex), is rigorous and scientific: and some of the best and most eager of the young people are enrolled. Architecture, music and psychology are called in: "the spaciousness, simplicity and very often the beauty of the surroundings of establishments in Germany were most noticeable". Singing is widely encouraged and "is invariably excellent". "Kraft durch Freude" (strength through joy) may have a slightly comic ring in English ears, but its appeal to the German masses is based on sound psychology and on skilful, arresting propaganda. This organization affects the lives of millions of young (and older) workers: it is generous and reasonable in spirit: it provides, apart from anything else, cheap, ready and beneficial holidays for the masses: it is "possibly the most instructive phenomenon of the Third Reich". If its cost is great, so also will be its result in health and happiness to the German people.

A free democracy such as ours is liable to be slow in its enthusiasms and to be inhibited by criticism, and it may be a long time before we learn to do for our young people what Germany is already doing for hers. A comparison of these pamphlets shows how far, in eagerness, in organization and in science we are behind. Our best, in physical education, is doubtless at least as good as the German best, but Germany is doing well for far more people. Britain may have little else to learn from national socialism, except by way of warning, but we shall be fools—or worse—if we allow prejudice to blind us to a real achievement in human betterment, if we refuse to acknowledge the one generous experiment which, whatever its motives, exaggerations and shortcomings, Nazi Germany is now making. A. V. HILL.

Enzyme Research

Ergebnisse der Enzymforschung

Herausgegeben von F. F. Nord and R. Weidenhagen. Band 6. Pp. x + 289. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 23.60 gold marks.

THIS year's volume of the "Ergebnisse" deals in the main with the remote sections of the subject and to that extent is of special rather than general interest. Inasmuch as progress on the experimental side depends on the development of new technique, some of the contributions are of importance. For example, two Indian investigators in Bangalore deal with the application of dilatometry to enzyme reactions, which involves the measurement of volume changes under carefully standardized conditions. Though the mechanism through which volume change is caused is not clearly understood, it is claimed that the validity of its application has been established in specific cases by a comparative and critical study. The practical difficulty is to be sure that the reaction, or rather mean result of possibly several reactions measured, is the one which the experimenter describes.

Perhaps the most interesting chapter is that by Hugo Theorell of Stockholm on the yellow ferment and its component, known in crystalline form as lactoflavin, which appears to be vitamin B₂ and about which so much has been discovered working with extremely small quantities of material. In the ferment, the presence of which must be regarded as essential to life, the lactoflavin is joined to a pentose sugar, phosphoric acid and protein, a combination which seems usual in the cell. It acts as a hydrogen carrier, the physiological problem being whence comes this hydrogen and whither it goes. Lactoflavin has been synthesized. The summary is a useful one of this most important subject.

Miss Stephenson, of Cambridge, writes of hydrogenylase—an alarming word to describe bacterial enzymes which produce molecular hydrogen from formic acid. The work done on this reaction indicates that since all substances so far known to yield hydrogen by bacterial action also yield formic acid, the hydrogen is liberated from this substance.

A somewhat lengthy paper contributed from Lwów, by J. K. Parnas, deals with the vexed question of the changes which take place during the breakdown of glycogen in muscle. The changes are complex, and they involve phosphates; there

is much controversial matter in the article, which would have been improved by a summary. The editors of the "Ergebnisse" should encourage authors, even in the most specialized fields, to make clear wherever possible the probable position in relatively simple language and not leave it to the unfortunate general reader to become lost in the confusion of contradiction and detail.

Everyone must experiment with heavy water in these days, and there is a section on ferment reactions in its presence from K. F. Bonhöffer of Leipzig. It is largely mathematical and does not make any particular point.

The chapter by Emil Abderhalden on the protective ferments demands careful study. Apparently when foreign substances of a hydrolysable character are introduced into the blood stream, it is not long before appropriate new enzymes appear capable of breaking them down, and these enzymes afterwards appear in the urine. These protective proteinases are characterized by being sharply specific towards the substrate which has called them into being. Their origin has not been discovered; they can be detected in blood serum and in urine within less than 24 hours of the introduction of the foreign substance. The subject is a new one and obviously of outstanding importance. It is interesting to note the two conflicting trends in enzyme theory—some emphasize the absolute character of the specificity, others consider a particular enzyme, for example emulsin, to have a wide range of activity though it acts on some substrates with extreme slowness.

Lastly may be mentioned an American contribution, by J. B. Summer of Ithaca, on antiurease, a member of the class of anti-enzymes of which sixteen have already been mentioned in the literature. Crystalline urease being available, it was possible to study the production of antiurease by injecting it into an animal. The author speaks of having made the purest antibody preparation yet obtained, though he has not yet succeeded in crystallizing it. This work is of importance.

These brief extracts must suffice to show some of the directions in which hopeful progress is being made. The work is truly international, the laboratories of the world are co-operating in it and it is worth while to stress this, the real and the predominant aspect of scientific chemical activity, as the true state of affairs, and to regard the excessive reference to warlike activities as largely an overstatement.

E. F. A.

The Rengma Nagas: A Changing Tribe

The Rengma Nagas:

By J. P. Mills. (Published by direction of the Government of Assam.) Pp. x + 381 + 17 plates. (London: Macmillan and Co., Ltd., 1937.) 25s. net.

MORE than fifteen years ago, the reviewer in *NATURE* of an earlier monograph in this series expressed the hope that it might be followed up by monographs on other Naga tribes including the Rengma, and Mr. J. P. Mills, honorary director of ethnography for Assam, in dealing with that tribe, has now filled in one gap in our existing knowledge, so that we have a series of works dealing with all the tribes occupying the middle of the major portion of the administered area of the Naga Hills.

The gaps in our knowledge have been filled in more ways than one, for while Mr. Mills has found less to say about the social organization, for example, of the Rengma, than he had to say about the Ao in his last monograph, he has given even greater details of minor observances, formulæ and superstitions of daily life. Thus we are told exactly what a man should do when he is going out to snare hornbills, or precisely what misfortunes befall a man who remarks how good a wild yam tastes.

The author is, by the way, perhaps too sweeping in describing the Great Indian hornbill as feeding "exclusively on fruits and berries"; at any rate, a tame one, which belonged to the reviewer and lived unpinioned in his garden, spent much time in searching for spiders in the thatch, and preferred butter even to mulberries. Incidentally, also, the Angami dye referred to in a footnote on p. 66 is made from the leaves not, strictly speaking, of an oak tree, but of the *Macaranga denticulata*, and, in order to obtain the true black, a cloth must first be boiled with macaranga leaves and then steeped in black mud, the iron salts in which act on the gallic acid from the tree to make a fast black.

Particularly interesting are the details which Mr. Mills gives of a purificatory ceremony of a kind not previously described, the reviewer believes, in any monograph of this series.

The Rengma are a tribe now split into three groups; one of these migrated westwards to the Mikir Hills in the first quarter of the nineteenth century; the other two remained in the Naga Hills, but have become widely separated by the northward migration of the Sema tribe. It is with the last two sections that Mr. Mills's monograph deals, and he speaks of them throughout with reference to the Naga Hills administrative district as the

Western and the Eastern Rengma, but the Middle, or Central, and Eastern would be more precise terms. It is unfortunate that official duties made it impossible for him to deal with all three groups, since the changes which have taken place in the westernmost group, everywhere in contact with other peoples, have been very great, and would have afforded an interesting, if depressing, example of the effects of cultural contact and subsequent sophistication.

Even so, Mr. Mills has some very important reflections to make on certain aspects of missionary teaching, particularly as to the policy sometimes pursued of discouraging the payment of marriage prices. The tendency of the mission has been, if not actually to discourage, at best to refrain from encouraging the practice of paying a substantial sum for the privilege of marrying a man's daughter. The practice is a healthy one, as it provides some economic insurance for proper treatment of the bride by her husband, who stands to lose the sum paid if his wife leave him under provocation, and for the good behaviour and fidelity of the wife, who in turn must refund the payment if she give good ground for divorce. In some Sema villages where the custom had been dropped on conversion to Christianity, a tendency was manifested towards a quite uncalled-for and unjustifiable putting away of wives, or desertion of husbands, since the unfaithful party stood to lose nothing by the change.

Mr. Mills defends the payment of marriage prices among the Rengma on similar grounds, and it might be added that the retention of the custom is particularly desirable in the interests of the bride where there has been a recent change from polygyny to Christian monogamy, and where the tendency towards marrying more than one wife is likely to show itself in divorce and re-marriage if there be no serious obstacle.

The Government of Assam is the one administration in the Indian Empire that has the wisdom, the foresight and the interest in good governance to produce a series of detailed accounts of the customs and lives of the peoples of primitive culture surviving in the wilder parts of its province. This one is more than worthy of its precursors; it is well produced, well illustrated and well indexed. Two misprints only (on pp. 69 and 92) were detected by the reviewer, but he badly missed a map. Both Mr. Mills and the Assam Government are to be congratulated on this addition to their unrivalled series of tribal monographs.

Mitogenetic Radiation and the Theory of Nerve Excitation

Mitogenetic Analysis of the Excitation of the Nervous System

By Prof. A. G. Gurwitsch. Pp. ii + 114. (Amsterdam: N. V. Noord-Hollandsche Uitgeversmaatschappij, 1937.) 3.75 f.

THE outcome of Prof. A. G. Gurwitsch's latest monograph is a new 'chain reaction' theory of excitation, based, in its more concrete form, on the experimental results described in the body of the book. The peculiarity of the new theory is that it allows for the existence of many qualitatively different states of excitation, while ignoring completely the electrical, thermal and chemical phenomena studied by classical methods. The more general considerations which appear in the concluding chapter will perhaps receive better attention, and will doubtless awaken the sympathy of those who, with Gurwitsch, feel that the study of electrical changes in artificially stimulated nerve affords an inadequate basis for the comprehension of the "unlimited variability . . . and the continuity of functional states" of the nervous system. These ideas are derived from Driesch and from Gurwitsch's earlier work on the "cerebral field", and owe little to his study of mitogenetic radiation.

The experimental foundation of the new theory is somewhat as follows: Resting medullated nerve, in common with many other biological systems, is said to emit a complex ultra-violet spectrum of exceedingly low intensity, which originates in the nerve fibre itself. The medullary sheath, although highly opaque to ultra-violet radiation of macroscopic intensity, contrives to transmit the radiation emitted from the nerve fibre by a remarkable chain process of absorption and secondary emission, so that it can conveniently be observed externally by its effect on the rate of division of yeast cells—an aspect of the subject that has already been subjected to destructive criticism (see *Biol. Rev.*, 10, 42 (1935); and *NATURE*, 133, 860 (June 9, 1934)). "Biological" spectral analysis of the radiation, and comparison with that produced by enzyme reactions proceeding *in vitro*, suggest that it can be used as an index of the chemical processes occurring in nerve. It is found that whereas the resting sciatic emits radiation due to glycolysis, oxidation and proteolysis, the stimulated nerve gives a different radiation, the composition of which depends on the mode of excitation—mechanical, electrical, reflex, etc. Thus, in Gurwitsch's opinion, the existence of a qualitative variability of states of excitation is established. Sub-threshold stimuli, moreover, also give rise to a propagated

disturbance, accompanied by characteristic chemical changes, so that the all-or-none law appears to be a mere artefact, ascribable to the too exclusive interest of classical physiologists in action currents, excitability, and so forth.

Not only does nerve show this variability of response to stimuli of the usual type; it also responds, with a propagated wave of chemical action, to intermittent exposure to mitogenetic radiation from some other source. This so-called "mitogenetic excitation" appears after a latent period of 0.001 sec., is transmitted at a rate of 30 m./sec., and its nature varies with the nature of the exciting radiation. A single line from the glycolytic spectrum, of wave-length 217–218 μ , say, will set up a propagated disturbance involving emission of this same line, and, in addition, of other lines of the glycolytic spectrum—one, for example, at 190–192 μ . An interesting case, as Gurwitsch puts it, of "antistokes". A pure glucose solution, it may be mentioned, shows a similar secondary excitation which travels through the solution at a rate of 10–12 m./sec.

With regard to the behaviour of the central nervous system, Gurwitsch has studied the radiation emitted from the surface of the optic chiasma, the optic lobes, the hemispheres and the medulla of a frog stimulated visually. He finds that the "visual act" is accompanied by emission of radiation from all these regions; the stationary spatial distribution intensities in the cortex are a function of the nature of the stimulus—varying, for example, when a white visual field is replaced by a moving black pattern on a white ground, although a half white and half black field gives the same pattern, whether the black or the white portion forms the upper half. The spectra from the optic nerve and the hemispheres are also different with stimuli of different colours.

Sufficient has been said to indicate the general nature of Gurwitsch's experimental evidence, although it is not possible in a short review to deal with all its complexities, and surely not necessary to indulge in any lengthy criticism. Gurwitsch's discoveries speak for themselves, and the reviewer may be forgiven for taking to heart the author's advice, in a footnote dedicated to his critics, "to act more cautiously in the future, in order not to find themselves in a ridiculous position". He may nevertheless be allowed to suggest that the discoveries in question are open to serious doubt on physical, chemical and physiological grounds.

J. B. BATEMAN.

The Nature of Human Nature:

and other Essays in Social Psychology. By Prof. Ellsworth Faris. (McGraw-Hill Publications in Sociology.) Pp. xii+370. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21s.

AMERICAN sociology has been often described as suffering from two major though mutually exclusive complaints: a tendency to systematization which borders on vacuous verbosity; or, in contrast, a raw empiricism satisfied with increasingly detailed descriptions and the endless and aimless collection of fact, numerical in preference. On the whole, this indictment is as unfair as in a few exceptional cases it is amusingly apposite.

The present volume by one of the veterans of American sociology is a proof that Prof. Faris—and he represents the best and most numerous group of his colleagues—can be at the same time concrete and theoretically inspired; interested in facts, yet always infusing them with theoretical insight and human sympathy. The volume consists of collected essays ranging over a variety of subjects, and written over a period of years.

Some of the chapters are vigorously controversial. His robust, almost brutal handling of Pareto will be a delight to those of us who dislike irrational fashions in science (or pseudo-science) and quasi-religious cults in abstract sociology. The chapters on race and racial problems show once more the American mind at its best. Prof. Faris is, needless to say, strongly opposed to all extreme racial theories. He does not, however, dismiss the factor of race as a mere figment but deals with it in a truly scientific spirit. The group of essays on ethnographical subjects are based on the author's personal acquaintance with Central Africa, where he has lived for seven years. In his treatment of psycho-analysis and behaviourism, in the fundamental problem of human instincts in society and in his discussion of the Jewish question, we find everywhere an outspoken, honest, shrewd and at the same time, widely read and rarely cultivated mind. The book is written in simple and direct English; it is witty and full of vigour; it is as interesting as it is instructive; it vindicates the scientific character of American sociology.

B. M.

Comets:

their Nature, Origin and Place in the Science of Astronomy. By Mary Proctor and Dr. A. C. D. Crommelin. Pp. xi+204. (London: The Technical Press, Ltd., 1937.) 8s. 6d. net.

THIS work is written in simple and non-technical language and for this reason it will prove attractive to the general reader. The student of astronomy too will find it a most useful book, especially for references, as it supplies very useful information on famous comet hunters and also on the history of some of our well-known comets, Pons-Coggia-Winnecke-Forbes, Halley, Biela, Encke, etc. There is a description of the return of Halley's Comet in 1910—a return which caused considerable interest in the astronomical world especially, as Drs. Cowell and Crommelin had devoted a lot of time to the

computation of the perturbations by the planets. They predicted the time of perihelion passage as April 17, 1910, and this prediction was correct to less than three days.

Miss Proctor's father, Richard A. Proctor, showed many years ago that there were insuperable difficulties against the theory of the capture of comets by planets, and this is discussed in the present book. Dr. Crommelin supports Proctor's position and has devoted much attention to the view that the comets are not extra-solar. He agrees with Proctor that the short-period comets were expelled from the giant planets, but considers that Proctor was in error in postulating this expulsion millions of years ago. Crommelin believes that it took place in comparatively recent times—a view which is supported by the well-known fact that these short-period comets are rapidly disintegrating and last only a few centuries, not millions of years.

The book has a number of useful illustrations and an index is a great convenience. It is a very readable and interesting work.

M. D.

Das Gallium:

eine kritische Würdigung der Erkenntnisse mit experimentellen Beiträgen. Von Dr. Erich Einecke. Pp. 155. (Leipzig: Leopold Voss, 1937.) 12 gold marks.

THIS monograph gives a detailed account of the element gallium, which is now available on the market. After a historical introduction, it specifies the sources of gallium and the methods of extracting the element from them. The physical and chemical properties of gallium and of its alloys and compounds, including organo-metallic compounds, and the analysis of gallium, are described with 450 references to literature and 15 patents. Since 1932 gallium has been separated from the by-products of the copper schist of Mansfeld by the Vereinigten Chemischen Fabriken at Leopoldshall, and the price is now about 10 marks per gram. The metal has a very low melting point, 29.78° , and remains supercooled much below 0° , and a high boiling point, so that its use in high-temperature thermometers in quartz has been the object of research. Gallium compounds have also found application in pharmacy. The book contains some original observations by the author and is a valuable survey of the present knowledge of gallium and its compounds.

Photography

By Dr. C. E. Kenneth Mees. Pp. xii+214+63 plates. (London: G. Bell and Sons, Ltd., 1936.) 7s. 6d. net.

IN January 1936 the "Christmas Lectures" at the Royal Institution were given by Dr. Mees. His book covers the ground of the lectures in a very readable and extremely well-illustrated way. The history of photography is fairly fully summarized in a chapter of thirty-three pages. Another chapter describes the manufacture of photographic materials. The remainder of the book deals with the principles and applications of photography.

Mechanics of Sport*

By Sir Gilbert Walker, C.S.I., F.R.S.

IN games with a ball in their most primitive stages, the ball may be simply a convenient lump to be thrown or hit; but effects of spin soon play their part. It is well known that Prof. P. E. Tait measured the starting speed of a golf ball and thought he had proved mathematically that its range could not be more than about two-thirds of the distance that his son proceeded to drive it. The cause lay in the upward force due to the under-spin, and the explanation of such an effect had been given by the late Lord Rayleigh, as well as in general terms by Sir Isaac Newton. Similar effects may be seen in a slice at golf, a swerve in cricket or baseball, or an American service at lawn-tennis.

Another game in which a swerve occurs is curling, and the path of a stone happens to have the same relation to its spin as that of a ball moving through the air. Now the bottom of a stone is not flat, but is hollowed, so that it is in contact with the ice over a circular line about 6 inches in diameter. Let us suppose that the direction of spin is such that the forward side is travelling towards the left. If we think of the sideways friction on the circle of contact, that in the front half of the circle is to the right and on the rear half to the left. Now the stone moves to the left, so the friction on the rear half must be the greater. But as the forward motion of the stone as a whole is retarded by friction on the ice, the pressure on the rear half must be less than that on the front half; and if the stone were moving over a glass plate the rear friction would be the less and the stone should swerve to the right. This actually happens. On ice, however, it swerves to the left and so there must be better lubrication on the front half, or greater pressure, than on the rear half. Now we know that when ice is not far from the melting point, pressure in excess of a critical value melts the ice and reduces the friction: it is this property that makes skating possible, for it produces a film of water between the skate and the ice. So there should be more melting in the front half; also a stone should refuse to curl when its pressure cannot melt the ice, that is, when it is very cold. This agrees with experience.

Curiously enough, there is yet another case in which rotation sets up deviation in the same direction as for a ball. It is that of a falling long strip of cardboard. As Maxwell pointed out, if a spin is started, the downward velocity will be

least after the plane of the strip has passed through the horizontal and greatest after passing through the vertical. So the couples tending to increase the spin will be greater than those tending to decrease it; and the spin will grow. Also the horizontal forces will be greater after the vertical position has been passed through, and the sideways motion will appear. An example of this may be seen in the bull-roarer, an implement used in magical rites by primitive men over a large part of the earth. When the bull-roarer is twirled round, the string describes a cone on the side indicated by the theory, and when it has twisted so far that it must start untwisting, the cone shifts over to the other side.

Some effects of the 'nap' of a cloth may now be considered. A billiards player learns by experience that the path of a ball travelling slowly with much 'side', that is with a rapid spin about a vertical axis, will be diverted to the right or left according as the spinning motion on the right side is with or against the nap. The deflexion may be something like an inch in the length of the table. I have seen pages of mathematical analysis vainly devoted to the subject. But if we state the result in the form that the path bends away from the side on which the nap is being rubbed up and toward that on which it is being rubbed down, the explanation is obvious; for on the rubbed-up side the effective surface is higher than that on the stroked-down side, and the ball moves, as it were, on an inclined plane.

Let us consider now some of the weapons of primitive people. Slings and stones are still widely used, but the range of an arrow or a throwing spear is much greater than that of a stone of the same weight starting with the same speed. A few efforts to throw a wooden stick five feet long by hand will show that, unless precautions are taken, there is a marked tendency for it to travel in the stable transverse attitude with its length at right angles to its path, so that the range is poor in the extreme. For steady flight with the axis longitudinal we must either provide resistance in the rear end, as in an arrow, or put the centre of gravity forward, or spin the weapon about its axis; in a throwing spear both the latter devices are commonly employed. The natural way to give the spin is by wrapping the thumb and fingers round the spear, so that it rolls off the hand on release. The assegai is thrown in this way, and flies like an arrow from a bow; its penetration is very great.

* Substance of a lecture delivered at Derby on September 6 in connexion with the British Association meeting at Nottingham.

In the course of time, primitive peoples have developed two devices for throwing, the spear-thrower and the beckett. The former is a stick about two feet long and in its use the spear lies along the spear-thrower with its butt resting against a projecting peg. This makes possible an invaluable flick of the wrist and, strangely enough, imparts a considerable spin. This would be impossible if the spear were not slightly 'whippy', so that an imperceptible flick to one side in its slightly bent state will apply a couple about its longitudinal axis. I believe that a range of 150 yards can easily be attained in this way.

The beckett is a short cord wrapped around the spear and also the first finger of the thrower's hand. It enables the wrist to be freely used and gives the valuable spin. The Roman *pilum* was thrown in this way with a thong called *amentum*.

A boomerang can to-day be looked on as an anticipation of the 'autogiro'; for as with the horizontal fan of the autogiro, its rotation provides support similar to that of the wings of an aeroplane. The couples necessary for its steering are produced partly by the warping of its plane and partly by the lack of symmetry in its cross-section. Returning boomerangs may describe paths of various types; we may have several circuits in front, or a figure of eight. But for an ordinary missile to be thrown at an animal, the shape is designed to give a straight and very flat trajectory. Its efficiency is considerable; when my range with a cricket ball weighing $4\frac{1}{2}$ oz. was seventy yards I could throw a straight-going boomerang weighing twice as much a distance of 185 yards. One of my literary friends used to maintain that a boomerang alighted rotating faster than when it left the thrower's hand; and I used to reply, with the cocksureness of a mathematician, that such a thing was impossible. But we are now familiar with the way in which, except in recent patterns, the rotation of the fan of an autogiro was provided, not by the direct drive of an engine, but by the forward rush of the machine through the air. So my literary friend was not far wrong.

A well-known tool of the Stone Age is the adze, of which the head, or celt, may have a curious property; when placed on a fixed plate of clean glass it may spin in one direction but not in the other. The celt is oval and at the point of contact with the plate the lines of curvature are not, in general, precisely parallel with the dynamical axes—the axes based on the distribution of matter. There is rotational asymmetry, and this shows itself when the celt is spun. Theory brings out another paradox; when tapped at one end rotation is set up, and the direction of this may be reversed merely by raising the centre of gravity.

Let us now turn to some problems of the motion of living beings. The art of swimming has been revolutionized by copying primitive peoples in methods so obvious that we ought to have thought of them. Thus in 1892 the record for the mile was 29 min. 25 sec.; it is now 21 min. 7 sec., an improvement of about forty per cent. In the crawl stroke the body is horizontal instead of sloping, so that the resistance is reduced and the energy is nearly all spent in propulsion, whereas much was spent in keeping the head out of the water. In it, also, useless resistance is not caused by moving the arms forward or sideways in the water, instead of backwards, and the legs, which are not well designed for propulsion, remain nearly straight; their movement, whether the flutter or the scissors, is made three or four times to one of the arms and has a very small range; its object is largely that of controlling the position of the body.

We will now consider a high jump. A good performer crosses the bar in a nearly horizontal attitude, so that as he approaches it vertically he would, unless something occurred, turn through another right angle in descending and alight nearly upside down. In fact he learns to make violent contortions to avoid a dangerous descent. Perhaps the best exponent of this art is the cat, which, if suspended by the paws with its back only a few inches above a table and released, will fall on its feet. It performs the whole operation of rotation in the air in about a quarter of a second. This can be illustrated by mounting a platform able to rotate without appreciable friction, when, by repeated use of the arms, a man can turn his body completely round as often as he wishes, although at no instant is there the slightest angular momentum about the vertical.

Another theme is that of sailing flight. In the tropics when the sun has sufficiently heated the earth's surface, we see kites and vultures flapping their way upwards until about fifty feet above ground; and then, having reached an up-current, their labours cease and they soar in spirals to a height of perhaps 2,000 feet; they may wander at will all day and descend at sunset. At the first glance it would appear from the inclination of the wings that the up-current would drive the bird backwards, not forwards, but on plotting the motion of the bird relative to the air and remembering that its wings are slotted the paradox is solved.

I believe that the mechanical efficiency of a modern sailplane easily beats that of a vulture, the flight of which is handicapped by carrying much flesh; so that in the tropics a skilful and experienced pilot should be able to roam all day at will. But even in our comparatively feeble European sunshine, the distance record is 313 miles and a height of more than 19,000 feet has been reached.

Tests in Common Use for the Diagnosis of Colour Defect*

By Dr. Mary Collins

THE testing of colour-blindness in all its forms presents a problem of great practical importance involving the adoption of a definite technique.

The spectrometer is undoubtedly the most fundamental test of colour vision, but it is seldom available for practical purposes, and the majority of tests, apart from those in scientific laboratories, are carried out either with some kind of lantern test or some kind of pigment test. There are various types of lantern tests available. The Edridge-Green colour perception lantern is the only one which has been used by the writer. A newer model is the Board of Trade lantern test, recommended with modifications by the committee set up to consider colour vision requirements in the Royal Navy. In using this the eyes have to be dark-adapted for 15 minutes. The Giles-Archer perception unit is also a new and simple model, and it, too, requires the eyes to be dark-adapted. These lantern tests, and many others, have the advantage that coloured lights are used instead of pigments, which brings conditions of testing nearer to everyday conditions in the Services, the railroad, navigation and aviation.

Certain pigment tests have also been extensively used, and it is these I should like to discuss in some detail. In some of these tests, it is puzzling to find mistakes made sometimes by individuals with normal colour vision which should only be made by colour-blinds. The printing of the tests may be partially to blame, but it must be recalled that decisions are constantly being made on the results from these tests, and therefore it is essential to recognize which responses are diagnostic and which can be ignored. In order to reach a valid basis for diagnosis, I have given a battery of tests under constant conditions of distance and illumination to an unselected group of about 340 candidates, exclusive of colour-blinds, applying to be accepted as apprentice printers. Their responses, therefore, to the tests may be compared with the responses of a group of colour-blinds tested under the same conditions. This normal group acts as a control group against which the results for each test used can be evaluated at its proper worth.

Owing to exigencies of space it will not be possible to discuss the details of the results obtained with all the tests which have been used. I can indicate the type of investigation under progress by giving the results from one of the tests only, "The Ishihara Tests for Colour Blindness" (5th Edition).

*Continued from page 534.

The Ishihara test is composed of a number of pseudo-isochromatic plates in which coloured numerals appear on coloured backgrounds. In some of the plates only part of a numeral appears to a person who is colour-blind, this being dependent on the colours used. For example, an 8 may be the numeral read by one with normal colour vision, but only part of it may be seen by the colour-blind, and he reads it as 3. Or a totally different numeral may be seen by the colour-blind from the arrangements of the spots before him, and instead of seeing a 5 as the majority would do, he sees a 2 standing out distinctly from the background. Further, in some plates, the position is reversed as it were, and although the person with normal colour vision sees nothing but a blur of colour, the colour-blind sees a numeral quite clearly. If one with normal colour vision looks at these plates through a blue glass, the 'hidden' numbers become visible.

The individuals forming the control group who were tested were found to vary markedly in their colour discrimination. It seemed advisable to divide them into two groups termed respectively *N* (normal) and *N*— (showing greater deviation from the normal). The classification is of necessity an arbitrary one because it is difficult to know where to draw the dividing line; in fact, the line of demarcation between colour-blinds and non-colour-blinds may itself vary according to the purpose in hand. In the report of the "Colour Vision Requirements in the Royal Navy", already referred to, it is stated of a certain test that if used alone it causes extravagant rejection of candidates who may be fit even for the seaman branch. This merely indicates that the standard for rejection can be changed in accordance with the post to be filled. It is interesting to note that three grades, so far as colour discrimination is concerned, are suggested in this report.

The colour-blinds in the present test have been classified thus because of their responses not to any single test but to at least six tests, and in some cases a spectrometric examination was also made. Similarly, in the *N* and *N*— groups, their allocation to these classes is based on the results obtained from the same battery of tests.

The accompanying table shows the results from the Ishihara test when given to these three groups. The percentage frequency of the responses in each group has been calculated with regard to normal responses and colour-blind responses. The table

is read thus: in plate 5, 56 per cent of group *N* read the figures correctly as the normal do, that is, read them as 74, whereas 11 per cent of group *N* read the figures as the colour-blinds do, that is, read them as 21. The frequency of responses other than normal and colour-blind has been omitted. In the *N*-group, 29 per cent gave the normal response, 31 per cent the colour-blind response. In the colour-blind group, 0 per cent gave the normal response, 81 per cent gave the colour-blind response.

ISHIHARA TEST.

Frequency in percentages of normal and colour-blind responses for *N*, *N*-, and colour-blind groups.

Plates	As read by normal	As read by C.-B.	Normal <i>N</i> . C.-B.	<i>N</i> - <i>N</i> . C.-B.	Colour-Blind <i>N</i> . C.-B.
1	12	12	100 0	100 0	100 0
2	8	3	100 0	100 0	40 55
3	6	5	100 0	100 0	21 71
4	5	2	99 5	92 4	12 74
5	74	21	56 11	29 31	0 81
6	2	—	99 0	83 1	0 100
7	6	—	100 0	96 4	5 95
8	5	—	100 0	98 2	5 95
9	7	—	100 0	100 0	2 98
10	—	5	91 4	89 6	0 95
11	—	2	72 27	48 48	0 100
12	26	2 } or 6 }	99 0	90 1	5 59 } 10 }
13	42	4 } or 2 }	100 0	100 0	10 55 } 26 }

The frequency of responses other than normal and colour-blind has been omitted.

N = 256 males; *N*- = 48 males; C.-B. = 45 males.

Plates 2 and 3 are never wrongly read by either the *N* or *N*- group, but Plate 3 seems the better diagnostic test of colour-blindness, as 71 per cent of the colour-blinds failed on it, and only 21 per cent passed. Plate 4 is equally good, although 0.5 per cent of the *N* group and 4 per cent of the *N*- group gave the typical colour-blind responses. Plate 5, which is read as 74 by the normal and as 21 by the colour-blind, is said by Miles to be "certainly the most sensitive indicator of colour weakness that we possess", and in the summary at the conclusion of the article, he suggests that in testing men for mercantile establishments only Plate 5 need be used at the original interview. It is also regarded in the "Report on Colour Vision Requirements in the Royal Navy" as one of the most searching plates. It is true that 81 per cent of the colour-blind read the figures as 21, and the others in different erroneous ways, but if we look at the results from the *N* and the *N*- groups, we must modify our opinion. Only 56 per cent of the *N* group passed, whereas 11 per cent failed, that is, read the 74 as 21. The remainder read the 7 as a 2 or as a 9 or as a 1, so that the figures read as 24 (7 per cent), or 94 (2 per cent), or 14 (1 per cent): or the 4 was read as a 1, and the numbers read as 71 (20 per cent), or 91 (2 per cent) or 11 (1 per cent). In the *N*- group, the

percentage of those passing is even smaller, 29 per cent, and the failures 31 per cent. The other variations also occurred. It may be, of course, that this plate offers a very delicate test of colour weakness, and therefore is very effective in picking out colour defect of varying degree. But sometimes it was the only error the individual made not only in this test but also in a group of tests.

The next four plates seem to be very significant. The normal group shows a perfect pass in all four and the colour-blinds almost a complete failure.

The next two plates containing the hidden numbers differ very much as regards efficacy for detection. The hidden 5 is certainly not visible to the normal eye, and the fact that 4 per cent with normal colour-vision saw it easily is a curious result. These 4 per cent have perfect colour vision on all the tests, and one would be almost inclined to rate them as *N*+. Whether the supersensitive see the 5 or not requires further investigation. The 2, on the other hand, is not satisfactory. It could be seen fairly easily by all groups, as will be evident from the percentages quoted. Twenty-seven per cent of the *N* group and 48 per cent of the *N*- group were able to read it.

The last two plates are very satisfactory.

The Ishihara test is a very reliable test of colour-blindness and did not allow any of the colour-blinds to pass. It also seems to detect colour weakness in a highly efficient manner.

The results from this test may be sufficient to give some idea of the type of investigation which has been carried out. A similar analysis of the results obtained with other pigment tests—the Stilling, Schaaff's mosaic plates, the Nagel, the Podesta, the Edridge-Green, etc., leads to similar conclusions, namely, differences in the value of individual tests, inconsistencies in the findings arrived at with any single series, and so on.

There is a good deal of doubt whether we ought to speak of reliability and consistency in connexion with the results of this analysis. It may be that the discrepancies disclosed are due to the great variety of those deviations from normal colour vision which are so marked as to justify their being regarded from a practical point of view as cases of colour-blindness. This interpretation of the facts is to some extent confirmed by the results of filter analysis. Plates which all profess to diagnose deuteranopia, for example, show very differently under filter analysis, and similarly evoke different responses from different deuteranopes. The inference would appear to be that we are dealing not with linear variations in degree but with multidimensional variations. A wide new field for investigation is thus disclosed, the working of which may yield valuable results for the whole theory of colour vision.

Work of the Discovery Committee

FIFTH COMMISSION OF THE R.R.S. *Discovery II*

THE Royal Research Ship *Discovery II* is again on the point of departure from London for the Antarctic: she is expected to sail from St. Katharine Dock on October 7 and will be away from England for twenty months. During this time she will be continuing the research on the distribution of whales, hydrology and plankton, the progress of which has been the subject of the recent report referred to in NATURE of September 25.

The first seven months (the southern summer) are to be spent in making a circumpolar cruise planned to provide data for comparison with those obtained on the winter circumpolar cruise of 1932 and with those of the survey of the southern part of the Pacific Ocean in 1934. A circumpolar cruise in summer was started in 1935-36, but this was not completed as it was necessary to revise the programme after a voyage had been made to the Ross Barrier to pick up the American airman Mr. Lincoln Ellsworth.

Leaving Cape Town in November, the ship will steam south-south-east as far as the edge of the pack-ice. On the way southwards a full station will be worked every day: this includes temperature measurements and collection of water samples from a series of 22-25 depths between the surface and the bottom, and the fishing of fine and coarse nets vertically and obliquely down to a depth of at least 1,000 metres.

When the ice-edge is reached, a course will be set towards the east, but tacks will be made north-east and south-east so that the conditions in the warmer water of the open sea to the north of the pack-ice can be examined as well as those at the ice-edge itself. While the vessel is to the southward of the Antarctic convergence—the boundary between antarctic and sub-antarctic conditions at the surface—a constant look-out will be kept for whales; estimations will be made of the relative numbers of Blue and Fin whales seen, and some comparison will then be made of the relative abundance of whales in the different sectors.

In Antarctic waters special nets will be fished for krill (the food of whales) and particular attention will be paid to the collection of young krill near the ice-edge. Where the ice conditions allow the ship to reach the continental shelf, there will also be more intensive work.

In order to complete the circumpolar voyage, the ship must steam northwards to Australia and

New Zealand to replenish her bunkers with oil fuel, and she is expected to be in Fremantle late in December and in Dunedin early in February. Further supplies of fuel will be taken from the Falkland Islands and South Georgia. On both northward and southward voyages the routine observations—at least one full station daily—will be continued; they will give sections across the Antarctic, sub-Antarctic, and sub-tropical zones, and comprehensive data for further research on the problems of the meridional circulations of water and plankton.

In the Atlantic Ocean four lines of stations will be worked across the cold current which flows towards the east from the northern part of the Weddell Sea, and observations will be made between 0° and 20° E. in the current that flows westward into the Weddell Sea along the fringe of the Antarctic continent. The purpose of these observations is to obtain a substantial sample of the krill population in the Weddell Sea current.

The ship is expected to complete the circumpolar voyage and to arrive back in Cape Town early in May 1938, and she will sail southwards again, in midwinter, about July 1.

The second half of the commission will be spent in the eastern part of the Atlantic Ocean and the western part of the Indian Ocean, and repeated lines of observations will be made along the meridians 0° and 20° E. The repeated cruises will only differ in so far as they are affected by the position of the ice-edge, and great care will be taken to preserve a uniform method of making all the observations so that comparisons of the results of successive cruises will be as valid as possible. The work will include observations on whales; measurement of temperature, salinity, nutrient salt and oxygen concentrations between the surface and the bottom; intensive plankton fishing—particularly for krill—down to a depth of at least 1,500 metres; and meteorological observations and bird counts. It is hoped to repeat the cruise—southwards along 0° , eastwards near the ice-edge, and northwards in 20° E.—at least seven times before April 1939, when the ship will return to England.

The director of research, Dr. N. A. Mackintosh, will accompany the ship during the first part of the work, and the scientific staff will include Mr. H. F. P. Herdman and Mr. A. J. Clowes as hydrologists, and Dr. T. J. Hart and Mr. J. A. Nicholson as zoologists. Lieut. L. C. Hill, R.N.R., is again in executive command.

At the recent Imperial Conference the possibility was mentioned of some form of co-operation between the Dominions in any form of economic or scientific activities which might be undertaken in the future in the Antarctic. In this connexion the governments of South Africa, Australia and New Zealand have been invited to nominate scientific or other workers to sail with the *Discovery II*, each for a section of the circumpolar cruise, in order to study the methods of research used by the Discovery Committee.

WHALE-MARKING VOYAGE OF THE R.R.S. *William Scoresby*

The Royal Research Ship *William Scoresby*, the Discovery Committee's smaller ship, which is now used mainly for whale-marking, has already sailed, the purpose of her early start being to search for

whales in sub-Antarctic waters before they have reached the Antarctic feeding-grounds. The route to be taken depends largely on the abundance and movements of whales. Fuel will be taken, however, at South Georgia in November, and it is probable that operations will then be extended eastwards towards Bouvet Island if ice conditions are suitable. In the second part of the season the ship will move to more westerly regions, near the South Shetland Islands and in the eastern part of the Pacific sector.

The *William Scoresby* sailed on September 16 and is expected to return about April 15, 1938. Mr. G. W. Rayner is in charge of the operations and Lieut. R. C. Freamer in executive command.

Some four thousand whales have now been marked and more than ninety marks have so far been returned.

Genetics and Taxonomy

VARIOUS articles and letters that have appeared in *NATURE* during the past few years suggest that workers in special branches of biology (particularly in cytology, ecology, and genetics) are showing an increasing interest in the impact of their discoveries on taxonomy, and that this interest is shared by their taxonomic colleagues. Papers and discussions at the annual meeting of the British Association may also frequently be accepted as an indication of what subjects are developing in scientific favour. At the recent meeting at Nottingham a morning was devoted by Section K (Botany) to "Genetics and Taxonomy", with a rather wider range in the papers and discussion than is suggested by this general title.

It would appear from Dr. W. B. Turrill's opening paper that plant taxonomy is to some extent at the cross-roads. The old orthodox (or 'alpha') taxonomy, based largely or entirely on morphology, has remarkable achievements to its credit and there is still much to be done by its traditional methods, especially in the floras of the botanically less explored parts of the world. On the other hand, the new methods, especially those with an experimental basis, are leading to the discovery of important characters or attributes, many essentially physiological, which show that the old classification needs improvement or even altering fundamentally if it is to be of the widest use. Cytogenetical investigations, while not the only lines of research which are making contributions to a new taxonomy, are of very considerable

value since they are throwing light upon the following problems which concern the taxonomist: the degree of plasticity of the genotype, the occurrence and constancy of correlation of characters, the occurrence and nature of sterility barriers, the evaluation of characters, the recognition of hybrids, and the phylogeny of species. Examples illustrating the influence of experimental investigations on taxonomic concept, with reference to the above problems, are furnished by the research at Kew and Potterne on species of *Ranunculus*, *Silene*, *Centaurea*, *Anthyllis*, *Plantago*, and other genera.

Not infrequently modern investigations support morphological classification, as Mr. W. J. C. Lawrence showed for the genus *Dahlia* and Dr. K. Blackburn for *Silene*. For an increasing number of genera, cyto-genetical and biochemical analyses enable rapid and precise comparisons to be made between species, thus providing the taxonomist with a further measure of the relationship and evolution of species. The work at the John Innes Horticultural Institute on *Streptocarpus* and *Delphinium* serves as an example.

In such a group of plants as the grasses, taxonomists have sometimes attached undue importance to easily observed but relatively inconstant characters. Dr. T. J. Jenkin suggested the desirability of close co-operation between the taxonomist and cytogeneticist in elucidating the history and behaviour of pasture grasses and thus preparing the way for a better general classification of these economically important plants than at present

exists. Problems of interspecific and intergeneric hybrids are the concern of both the cytogeneticist and the taxonomist, as is also the determination of phylogenetic relationships. The taxonomist has to evaluate the characters he uses, making some of generic, some of specific, and some of varietal value, and so on. In *Lolium*, genetical research shows that height has little value as an indicator of relationships and specific distinctness, since a plant two inches high may be a sib to a plant twenty inches high. In the genus *Dahlia*, corolla colour definitely characterizes two groups of species and the wide colour range shown by the garden *D. variabilis* is, in agreement with other evidence, a witness to its origin as a hybrid between species of the two groups. Such examples of recent research illustrate the help the taxonomist may expect from the biochemist and cytogeneticist in his attempts so to classify plants that the classification is not only widely useful but also indicates relationships.

In return for such help the taxonomist can assist his colleagues not only by identifying their original material on the basis of 'alpha' taxonomy, but also by indicating problems which are recognized as unsolved by the older methods. Prof. J. R. Matthews gave examples of closely allied species which were probably derived from a common ancestral stock but which have now a different geographical range. Cytogenetic research on such plants as *Ranunculus Flammula* and *R. reptans*, *Calltha palustris* and *C. radicans*, *Primula farinosa* and *P. scotica*, combined with other methods of investigation, might lead to the formulation of general views regarding the influence of isolation in speciation. Knowledge of the origin of the geographical race or subspecies may well give us a more complete knowledge of the origin of species.

The results of modern lines of work are beginning to influence taxonomic thought by making taxonomists consider the logical basis of their classification. There seems a general agreement that 'alpha' taxonomy (based essentially on morphology) should be maintained for the present. Subsidiary classifications, often based on a very limited and deliberately abstracted number of attributes are, however, essential for special purposes and especially for deductions from correlation of attributes. Such a classification as that of Turesson, which was ably advocated in the discussion by Dr. J. W. Gregor, has a considerable value both as a means of stating and comparing the results of eco-genetical research and as a guide in the practical application of such research to agriculture. Such special classifications, however, cannot replace a more general one, and exactly how far they can be combined with morphological criteria to lead to a practical and logically sound classification is a matter for continued experiment. As Dr. Turrill said: "by trials and errors this 'experimenting taxonomy' will enable, one hopes, orthodox relatively stabilized taxonomy to incorporate new data and so to advance, gradually and cautiously, from an alpha position towards a far-off omega perfection of the classification of all biological knowledge".

The formation of the Association for the Study of Systematics in Relation to General Biology (see NATURE, July 24, 1937, p. 163 and Aug. 7, 1937, p. 211) was cordially welcomed at several sectional meetings of the British Association. It has evidently awakened considerable interest amongst biologists and should do much to stimulate and co-ordinate research into the many problems of equal importance to taxonomists and their colleagues in other branches of biology.

Obituary Notices

Prof. Albert Heim, For. Mem. R.S.

THE news of the death on August 31 at the age of eighty-eight years of the veteran geologist Albert Heim, though not unexpected, comes as a sad shock to many admirers. A very great man has gone, and a treasured connexion with the early days of Alpine structural interpretation has at last been broken. As a student, Heim came under the spell of Arnold Escher von der Linth, an open-air researcher, a great talker, but no writer. Heim loved the mountain side no less, but fortunately he was an artist, excelling with both pen and pencil; and in his early publications he preserved in truly glorious fashion Escher's discoveries, enriched by numberless observations of his own. Heim's technical skill was such that he

himself engraved the copper plates of many of the illustrations that adorn his text.

The great drama of Heim's scientific life had its origin in one of Escher's favourite ideas, the 'double fold' of the Glarus. In 1841 Escher argued for the existence of 'colossal overshoving' of older rocks on to younger in the Canton of Glarus. He wanted to make the displacement involved as small as possible, and, as the cover of older rocks was discontinuous, he presently imagined that he could explain their situation by postulating two shoves from opposite directions, each with rather less than half the magnitude required if the shove were single. Heim adopted this theory in his classic "Untersuchungen über den Mechanismus der Gebirgsbildung", published in 1878;

and he maintained it for many years in face of slowly developing opposition.

We may recall Marcel Bertrand's paper unifying the movement in 1884, Suess's conversation with Heim in the same sense in 1892, and Schardt's one-way interpretation of Pre-Alpine tectonics in 1893. Schardt's revolutionary ideas led on to Lugeon's synthesis of Swiss Alpine structure considered as a whole, published in 1902. Lugeon was a pupil of Heim's, and while his masterpiece was passing through the press he received a noble letter from his old professor, in which the latter confessed that he now favoured Bertrand's interpretation and expressed joy at the new vision that had come.

The marvel of Heim's career is that it began in early youth and culminated in old age. When only twenty-four years old, Heim succeeded to the chair of geology at the Polytechnic in Zurich, and in the following year to that at the University of the same town, and held both posts until 1911; and yet, in 1919-22, he produced his three-volume "*Geologie der Schweiz*", the finest national text-book that is ever likely to be written.

Heim was keenly interested in many aspects of geology besides tectonics. Here there is only room to mention his work on glaciers, of the erosive powers of which he did not have a high opinion.

Heim became a member of the Swiss Geological Commission in 1888, and directed its activities from 1894 until 1925. With C. Schmidt he published a very valuable map of Switzerland on the scale 1:500,000. He received honorary doctorates from Bern, Oxford and Zurich, and was elected a foreign member of the Royal Society of London. He has left a distinguished son, Arnold, called after Escher, who was truly helpful to his father during the latter half of his long life's work. E. B. BAILEY.

Lord Rothschild, F.R.S.

In Lionel Walter Lord Rothschild, who died on August 27 at the age of sixty-nine years, a scientific worker has passed away of whom it may justly be said that he was better known at home and abroad than any other contemporary zoologist. It was inevitable that a Rothschild deeply interested in biology and possessing large zoological collections which he was indefatigable in increasing for the benefit of science, should inspire the imaginative Press of many lands to publish fanciful reports, which gave him a publicity often very embarrassing and inundated him with offers of collections and service and with requests for help. But he would have gained high distinction in science without a family name already world-famous. His interest was so intense and so wide, his ever-ready support of science so valuable and his scientific publications so important, that he held a high place of honour in zoology and was elected an honorary fellow by many foreign scientific societies. Entomologists, ornithologists, herpetologists and mammalogists all claimed him as one of their own.

Being of delicate health as a boy, Rothschild was educated at home and then spent some years at Bonn and Cambridge, following all the time his great love for natural history. The boyhood collections of Lepidoptera and Coleoptera increased to such an extent that in 1889, when he became of age, he built a cottage at Tring for the safe housing of the collections, and soon after a public museum in which were exhibited mounted specimens of all classes of animals. Following family tradition, he entered the bank of Messrs. N. M. Rothschild and Sons to study finance, which left him little time for the supervision of the growing collections. In 1892, on the recommendation of Dr. Albert Günther, he put Mr. Ernst Hartert, the ornithologist, in charge of the collections, and six months later entrusted the Evertbrates to the care of the writer of the present lines. It became the definite policy gradually to build up in the research department collections of birds and Lepidoptera as complete as possible, and to increase the public department as resources permitted.

In 1888, Rothschild had bought a collection of New Zealand birds from Sir Walter Buller, and he became so interested in the faunæ threatened by the spread of the white race that he sent a bird-collector to the Sandwich Islands, took up the study of the giant tortoises restricted to the Galapagos and Mascarene Islands, and of marsupials, and supported all measures for the protection of animals and plants by the creation of Nature reserves. His reputation as a zoologist was established before he was thirty years of age. In 1898, the University of Giessen conferred upon him the degree of Dr.phil. and in 1899 he was elected a trustee of the British Museum. He gave up finance in 1908 and then could devote himself entirely to science and to civic duties. From 1899 until 1910 he represented Mid-Buckinghamshire in Parliament, and in 1911 he was elected a fellow of the Royal Society in recognition of his services to the natural sciences. He travelled a good deal in Europe and North Africa, but being a bad sailor never visited the tropics. On the death of his father in 1915 he succeeded to the title.

At the time of Lord Rothschild's death the buildings of the museum had an aggregate floor-space of nearly an acre and a half. The public department now contains more than 2,000 mounted mammals, among them 13 gorillas, 25 chimpanzees, 24 echidnas, more than 200 marsupials; among the 2,400 mounted birds there is a magnificent series of 62 cassowaries, the great auk and other extinct species. The research department lost in 1932 the collection of 280,000 bird skins, which a sudden heavy call on his finances compelled Lord Rothschild to sell; the large collection of eggs contains the best series in museums of eggs of birds of paradise and two great auk eggs; but the greatest asset is the collection of some two million Lepidoptera invaluable for the study of geographical variation and other problems of evolution. The collections were placed with great liberality at the service of scientific workers, who always found a cordial welcome at Tring. The museum is left to the trustees of the British Museum.

KARL JORDAN.

President Masaryk

By the death of Prof. Thomas Garrigue Masaryk on September 14, Czechoslovakia has lost its first president and the world is deprived of an eminent and much-respected philosopher and statesman.

Thomas Masaryk was born of humble Slovak parents at Hodonín, Moravia, on March 7, 1850. He had a chequered boyhood and youth. A primary school inspector secured for him the consent of the authorities to allow him to attend a secondary school to train for a teaching post. His parents' poverty, however, made it necessary for him to earn his living, and he was apprenticed first to a locksmith in Vienna and then to a country blacksmith. A former teacher arranged for his return to school, and in 1865 he entered Brno Grammar School. He made good progress, but his passion for truth brought him into conflict with the authorities, who forced him to leave. Fortunately, he was able to continue his studies at Vienna where, in 1878, he graduated as a doctor of philosophy.

A work on hypnotism in 1880 was followed by "Suicide and Modern Civilization" (1881). It was an analysis of causes of the high number of suicides recorded in Central Europe, and attracted attention both at the time and later. This philosophical study secured for Masaryk a Vienna lectureship, but in the following year he was made a professor at Prague. In 1885 he completed a lengthy work, "Concrete Logic", having previously written several shorter philosophical works, which were also translated into German. His later books mostly took on a political aspect. Thus "The Czech Question" appeared in 1895, and the "Philosophical and Sociological Foundation of Marxism" in 1898. Besides writing for the literary and philosophical journal, *Čas* (Time), which he founded, he kept in touch with science sufficiently to contribute a weekly scientific column in the Prague newspaper, *Národní Listy*. He did not identify himself with blind nationalism, and his scepticism (justified as investigation proved) of the genuineness of some alleged old Czech manuscripts brought him much abuse.

From his philosophical studies he was led to the formation of a 'Realist Movement' amongst educated Czechs. This was "an attempt to popularise the whole realm of Science and Philosophy. Without distorting scientific exactitude, Realism strives to render science accessible to every class of the people. It is a protest against the monopoly of learning, its endeavour is to socialise scientific learning and philosophical culture".

In 1878 Masaryk married Miss Charlotte Garrigue, a distinguished American, and incorporated her name in his own. She entered ardently into all his work until her death in 1923. They paid several visits together to England, America and Russia, and Prof. Masaryk continued to write many philosophical works dealing particularly with modern problems. He entered the Austrian Reichsrat as a 'Realist' in 1902, and rapidly made a reputation for honesty and uprightness, and he was quick to express his dissatisfaction at the methods practised, it appeared, by

all parties. His realism was a reaction against this and against the Tolstoyan slavonic philosophy of non-resistance to evil. Just before the Great War he wrote "The Philosophy of History and Religion in Russia", one of the most important books on the subject, whilst after the War he described his work for Great Britain and the allies and for the liberation of the Slavs. He was, for a time during the War, a professor at King's College, London.

On October 28, 1918, the Czechoslovak Republic proclaimed its independence with Prof. Masaryk (still in exile) as its first President. He held this post until December 1935, when he relinquished it with the recommendation that his younger collaborator, Dr. Eduard Beneš, be elected to succeed him. During the seventeen strenuous and difficult years of his term of office, Masaryk gave very active support to many educational movements. The new University of Brno was named in his honour, whilst the Masaryk Academy of Work, which concerns itself with supplying funds for researches in pure and applied science and in securing publication of the results, received his very keen approval and valuable support. Masaryk was in no small measure responsible for many educational advances associated with his country. Through his ministers, he was able to institute an enlightened policy advancing not only the hitherto restricted culture of the Czechoslovaks themselves, but also not overlooking the needs of the German, Hungarian and Polish minorities living within the frontiers of Czechoslovakia.

Prof. Masaryk leaves a son, Mr. Jan Masaryk, the Czechoslovak Minister Plenipotentiary in London, a married daughter and Miss Alice Masaryková, who had been his companion during the last years and is well known for her Red Cross and humanitarian activities.

G. D.

Mr. F. A. Potts

We greatly regret to record the death in London on September 15 of Mr. F. A. Potts, University lecturer in zoology and fellow (formerly tutor) of Trinity Hall, Cambridge. He was a member of a remarkable group of young men who were specializing in zoology at Cambridge in 1906-8, his group including Prof. W. E. Agar (Melbourne), the late Dr. W. S. Perrin (London Hospital) and the late Rev. S. A. McDowall (Winchester). In his final examination he obtained first classes in both zoology and geology, being one of the last students to obtain the double honour.

Mr. Potts, after visits to Naples and Plymouth, then settled in Cambridge, assisting in the teaching of the Zoological Department until the outbreak of the Great War. During this period he became well-known for his activity in the then rather modern lines of research. He directed his interest first of all to the effects of *Pellogaster* and *Sacculina* on their crustacean hosts, *castration parasitaire*, extending this to a general consideration of phenomena associated with parasitism. His next investigations were devoted to the Rhizocephalan *Mycetomorpha* and to Nematoda, here a notable research dealing

with the free-living, hermaphrodite species. In 1913 he commenced an association with A. G. Mayer which continued until the latter's death in 1923. He several times visited the Carnegie Station off Florida, and in 1913 joined the Carnegie Expedition to Torres Straits. This association produced three important researches, now almost classical, namely: on the Rhizocephalan genus *Thompsonia*, which gave suggestions as to the evolution of the group; on the crabs forming galls in corals, including a study of their modes of life and their adaptations; and on the Crustacea, Ophiurans and Polychaets in association with the Crinoids of coral reefs. A post-War visit to Samoa and to further coral reefs was responsible for studies of rates of growth of Cirripedes and other forms. In addition to the above, there are a series of papers dealing with the systematics of Polychaets of the Indian Ocean and an important study of *Teredo*.

On the outbreak of the Great War in August 1914, Mr. Potts was much exercised as he had been brought up to abhor war—but he felt strongly the devastation of Belgium and Louvain. His brothers had families and could not serve; therefore he must play the family's part. He at once put himself in training and in November almost "coerced" the colonel of one of the Duke of Wellington's West Riding battalions to give him a commission as he "had to get out to the trenches before Christmas". He was a great success, keeping the mess cheerful, and on the formation of a machine gun section was placed in charge "because he knew all about science". He was there on the Western front for four years—and the writer, knowing his upbringing, his psychology and his extraordinary powers of imagination, feels that here was the highest form of courage.

Mr. Potts was a man with a host of friends, whose sympathy will go out to his widow and son. He was always cheerful, bright, happy, helpful and full of fun. In his teaching he dealt with every grade of student and liked to undertake new courses; his special subjects were worms and molluscs. He was thus eminently suited to the production as editor of that text-book on "The Invertebrata", in which he was associated with Borradaile, Eastham and Saunders, and to which he devoted the last years of his life.

J. S. G.

Prof. J. E. Duerden

THE death of Prof. James Edwin Duerden, which occurred on September 4 as a result of a fall sustained on his way to attend the meeting of the British Association at Nottingham, removes a man who has rendered devoted service to science in many fields.

Prof. Duerden was a student at the Royal College of Science, South Kensington, during the years 1885–1889, and obtained his associateship of the College in zoology. His first appointment was as demonstrator in biology and palaeontology at the Royal College of Science, Dublin, where he developed an enthusiasm for marine work, resulting in valuable published contributions to knowledge of the Hydroids and Polyzoa of the Irish coast. During this time, he was appointed

a member of the Irish Fishery Survey. In 1895 he accepted the position in Jamaica of curator of the Museum at Kingston. Here he commenced a series of studies of the Actinaria and corals of the West Indies. He pursued his investigations into living and fossil corals at the Johns Hopkins University, Baltimore, U.S.A., and was appointed Bruce Fellow there in 1901.

The value of Duerden's work was recognized when the Carnegie Institution of Washington granted him facilities for the study of European fossil corals, and he was also selected as leader of an expedition to the Hawaiian Islands to study Pacific corals. He was soon recognized internationally as an authority on the structure and development of corals, and became assistant professor of zoology in the University of Michigan. In 1905, he was appointed professor of zoology in the new Rhodes University College, Grahamstown, South Africa. Whilst there, he was placed in charge of ostrich investigations for the Government. He quickly became an authority on the development of ostrich plumes and showed how the serious defects known as bars in the feather were produced by a reduction in blood-pressure during the night period. After the slump, in 1913, of the ostrich plume industry, he became interested in the scientific aspect of wool production, and was appointed Director of Wool Research in the Dominion, whilst retaining his professorship at Grahamstown. He was a pioneer in work on the assessment of quality in the fleece and studied the embryology and evolution of the South African merino fleece.

Duerden served successively as president, member of council and honorary secretary of the South African Association for the Advancement of Science. He retired from Grahamstown in March 1932 and became an honorary member of the staff of the Wool Industries Research Association at Torridon, Leeds, in May 1932. Here he followed up embryological work on the coats of British sheep, specializing on follicular arrangement, and arrived at important conclusions on the specificity of the follicle. At the time of his death he was collating his results prior to publication. His enthusiasm and personality made him a delightful colleague and an inspiration to all who worked with him.

WE regret to announce the following deaths:

Prof. D. H. Bergey, formerly professor of bacteriology and hygiene in the University of Pennsylvania, known for his work on food preservation, on September 5, aged seventy-six years.

Prof. H. H. Collins, professor of biology in the University of Pittsburgh, known for his work on mammalian anatomy, on August 31, aged fifty-two years.

Prof. Adolf L. F. Lehmann, in 1909–30 professor of chemistry in the University of Alberta, and earlier associated with the Department of Agriculture of Mysore, on September 27, aged seventy-three years.

Senator Alessandro Lustig, formerly professor of general pathology in the University of Florence, known for his work on bubonic plague and sanitation, on September 23, aged seventy-nine years.

News and Views

The Globular Corona

THE sensational and distorted press comments on the coronal photographs secured from the stratosphere at the total eclipse of the sun last June, to which reference was made in *NATURE* of August 21, p. 310, have now been followed by more reasoned statements about the photographs. They amount to this: the photographs show more clearly to the eye what the measurements of von Klüber (*Z. f. Astrophysik*, 3, 159; 1931) and others have already proved, namely, that the successive isophotes of the corona round the sun are nearly circular. Graff, Bergstrand and Ludendorff were early workers in the same field of study and they have shown the differences in the behaviour during the solar cycle of this more regular corona and the superposed streamers. That some essential difference exists in the nature of the two main constituents of the corona was shown by the difference in the polarization between the inner corona and the streamers noted by Newall so long ago as 1905 and referred to again in a letter by K. G. Zakharin which appears in this issue of *NATURE* (p. 586).

The Storstrøm Bridge

A SHORT history and description of the Storstrøm bridge connecting the Danish islands Falster and Møn, which was opened by King Christian X on September 28, appears in *The Times* of September 25. Møn was linked up with Zealand by the Mønsund Bridge constructed in an earlier section of the bridge building programme initiated in 1933. The Storstrøm Bridge, which crosses an arm of the Great Belt, curving in a wide sweep of more than two miles, has been built for the Danish State Railways by the British firm, Messrs. Dorman Long and Co., Ltd., and completed seven weeks before the scheduled date. In its construction, the new 'chromador' steel, which has improved corrosion-resisting properties, has been used. The bridge has three navigable spans, the centre one 430 ft. in length and with about 80 ft. headroom, and forty-six shorter spans in the approaches. Tidal conditions, pack-ice and sea-scour were provided for by new and ingenious methods adopted in the building of the concrete and granite piers and in the erection of the steel girders. The bridge is described as being of a slender appearance but having a magnificence which can best be appreciated when the aluminium coloured steel is viewed in the morning sunshine. It provides a carriage way, a foot and cycle track, and a single line of railway on which trains can pass at a speed of 50 miles per hour. It completes the railway link between the Continent and Scandinavia for, by its opening, trains or cars can now run, via Warnemünde train-ferry, from Hook of Holland, Paris and Berlin, direct to Copenhagen, whence they can proceed by another train-ferry to Malmö, so that the Danish route now

compares favourably with that via Trelleborg-Sassnitz. It has the additional importance that it makes possible the extended use of modern streamlined 'lightning' trains in consequence of the longer journeys now undertaken.

Bimillenary of the Emperor Augustus

ON September 23, Signor Mussolini inaugurated the celebration of the bimillenary of the Emperor Augustus Caesar, who was born on September 23 in the year B.C. 63, by declaring open the "Augustan Exhibition of Romanism". Great Britain was represented by delegates from the British Museum, the Society of Antiquaries of London, the Societies for the Promotion of Hellenic and Roman Studies, and the University of London. The assistance which had been given by Great Britain in the preparation for the exhibition was generously recognized by Prof. G. Quirino Giglioli, who has been responsible for its organization—the work of five years. Nor does this long period of preparation seem excessive, when the vastness of the field covered by the exhibition is taken into consideration. Not only do they illustrate every side of life and culture of the city of Rome itself as the centre of the Empire, but they also include reproductions of the most remarkable monuments Rome has left in other parts of the ancient world. Further, they cover the religions, the arts and the material culture of the many and varied peoples who came under the sway of Rome, as well as trace in a special section the rise and growth of Christianity from the birth of Christ down to the Edict of Constantine. In this aspect the exhibition has a double significance for the archaeologist and the historian. On one side it emphasizes an internal mobility of peoples and cultures, which at a momentous phase in the history of civilization brought about such an interchange of beliefs and ideas as that, for example, which left for the contemplation of later generations a characteristic emblem of the eastern Mithraic cult in north Britain below the Roman Wall. At the same time, from the other side, it demonstrates the solidarity of the Empire, as against the rest of the ancient world, which has set its seal on European peoples, the heirs of imperial culture, no less effectually than the more familiar contrast of East and West.

Racial History in the Arctic

DR. ALĚS HRDLÍČKA, of the Smithsonian Institution, Washington, D.C., on his recent return from his ninth expedition of anthropological investigation in the arctic regions of North-West America, has issued through the Smithsonian Institution a preliminary report on the results of his season's work in the Aleutian Islands, in which he discusses the character and distribution of early racial types in the Far North. The investigations and excavations carried out by

Dr. Hrdlička in 1936 and 1937 have been directed more particularly to the study of the problem whether racial migration from Asia, in addition to the Bering Sea route, may have made use of the more southerly passage by the Aleutian Islands—a suggestion which on a general line of argument would appear to have much to support it, but for which until recently positive evidence has been regarded as inadequate. In the expedition of 1936, it may be remembered, evidence was obtained which was held to support Dr. Hrdlička's view. Skeletal material and a large quantity of archaeological material accruing from the expedition's excavations in 1937, and now awaiting further detailed examination in Washington, Dr. Hrdlička holds, confirm his previously formulated theories, and afford him a basis for the racial classification to which reference is made above. "The finds," he states, "make more probable than ever the hypothesis of a 'race nursery' in the Far North for the aboriginal population of the New World."

BRIEFLY, Dr. Hrdlička's preliminary conclusions are that the present-day Aleutians, a broad-headed people, who do not fall precisely into either an Indian or an Eskimo classification, were preceded by an oblong-headed race, who had a much longer occupancy. This race he regards as the same as that which he discovered in the deepest parts of his excavations on Kodiak Island in 1931-35; while a similar type has been found in the lower layers of a mound at the mouth of the Frazer River, British Columbia. There are indications that this stock may have spread so far south as California. The Aleuts cannot be regarded as descendants of this people, and may, in fact, represent a backward migration from Alaska towards Asia. Dr. Hrdlička is now prepared to recognize in the North-West, not one or two racial types, as previously held, but five distinct, though basically related strains, as follows: (1) the long- and high-headed Eskimo of the Seward Peninsula, Barrow, and eastward along the arctic coast to Labrador and Greenland; (2) the broad-headed and medium-vaulted Eskimo of the Bering Sea coast and along the interior rivers from the Yukon southward; (3) the Aleuts with broad heads and low-vaulted skulls; (4) the Alaskan Indians; (5) the oblong-headed pre-Aleuts, whose remains were found by the expedition in the exploration of the past season. The archaeological finds included a new stone industry belonging to this people.

"Minnesota Man"

FURTHER investigations by Prof. A. E. Jenks in the northern lake area of Minnesota, from which were obtained the skeletal remains described elsewhere in this issue of NATURE (see p. 596) have brought to light evidence of what would appear to be an extensive camping ground of early man. From a kitchen midden buried some three feet under a bog of grasses and marsh weeds in Itaska State Park, Prof. Jenks has excavated some two thousand knife-marked bones, with knives of stone and other implements of both stone and bone. The bone bed varies in

thickness up to about four feet five inches. Associated with the bones of bear, elk, caribou and other big game animals in the kitchen refuse are the remains of an extinct form of bison (*Bison occidentalis*), confirming the early character of the site and the early date of its occupation by man. Prof. Jenks states in *Science* of September 10 that of five stone artefacts recovered from the bone bed, three are flake implements with retouch, while two are chopping tools, chipped to rough parallel faces, and retouched on the cutting edges.

Roman Jerusalem

THE discovery of an interesting and important relic of the Roman occupation of Jerusalem is reported. The Department of Antiquities, it is stated by the correspondent of *The Times* in the issue of September 28, while conducting excavations in connexion with the plan of the municipality for clearing away buildings from the Damascus Gate, has brought to light a Roman moulded plinth ten feet high, of which the top was found at a depth of thirteen feet below the surface. The plinth consists of massive blocks of stone, which, it is said, recall the finest work of the Roman period. The site has been identified provisionally with the city gate beside the "Women's Towers", mentioned by Josephus. It is hoped that excavation will be carried further in the expectation that it will throw light on the much-discussed problem of the Third Wall of Jerusalem.

Brood Diseases of Bees Investigations

EARLIER in the present year an appeal was made to beekeepers and beekeeping associations to support financially the continuation of the research on brood diseases of bees at Rothamsted Experimental Station. This work had been carried on for three years by Dr. Tarr with funds half of which were provided by the Government and half by the British Beekeepers Associations. The results of the first three years' work were so promising that it was unanimously decided by the Bee Research Advisory Committee at Rothamsted to continue for a further period of three years if possible. The estimated cost is £550 per annum, of which the Agricultural Research Council has promised £300, if £250 per annum can be raised from other sources. As the result of the appeal a sum of £226 has been received for the current year, which leaves a balance of only £34 to be made up. For the two following years, there is only at present a guaranteed fund of £103 per annum.

THE work carried out up to the present has already cleared up many difficult points. Dr. Tarr has shown that European and American foul brood are two distinct diseases caused by different organisms. He has confirmed that American foul brood is due to a bacterium, *Bacillus larvæ*, and that its incidence is independent of the strength of the colony. European foul brood, on the other hand, is a disease of weak stocks and is probably caused by *Bacillus pluton*, in association with other organisms. He has also shown that a third condition known as 'addled brood' is

very prevalent in Britain; it constituted about one third of the cases of so-called foul brood sent in for examination. It is liable to be mistaken for foul brood, but is really due to a defective condition in the queen, and once it is recognized can readily be cured by requeening. The work in the next three years will be concentrated on tests of control measures for both European and American foul brood and further work on the organisms causing European foul brood. It is to be hoped that further support will be forthcoming to supply the small amount still required for this year's work, and that as many contributors as possible will continue to subscribe for the three years.

Regional Planning in the United States

A broadsheet issued by PEP (Political and Economic Planning) describes some developments in regional planning in the six New England States of the U.S.A. which are of some interest in relation to the Special Areas Bill in Great Britain. The broadsheet is based on a report prepared by the Commission on Regional Planning for New England, issued last year by the National Resources Committee, a progress report, "State Planning, Vermont", issued by the State Planning Board of Vermont, and on general reports on "State Planning (Review of Activities and Progress)" and "Regional Factors in National Planning", both issued by the National Resources Board. While the population of the United States as a whole increased by more than 140 per cent between 1880 and 1930, that of New England increased by little more than 100 per cent and that of the State of Vermont by less than 10 per cent. Seventy-seven per cent of the New England population is now urban, and only 6 per cent remains on farms. Simultaneously, the occupied population has declined to 42 per cent (as against 47.2 per cent in England and Wales), the long established shrinkage of employment in agriculture, forestry and mining being accentuated by contraction of employment in manufacturing and mechanical industries. These contractions are balanced by expansion of employment in trade, transport, professional, public, clerical, domestic and personal services.

A SIGNIFICANT feature is the large increase in part-time farmers, and about one third of the area is still in farms. Attempts are being made to classify farms in relation to their suitability for profitable agriculture. It is anticipated that expansion of milk production on the better farms, for example, would more than make good any loss through winding up uneconomic holdings. The problem of the hill districts is also being tackled by a programme of woodland development and especially in planning for recreation. In building up a recreation industry, whether in relation to preservation of scenery and amenities, alliance between recreation and forestry, sports, improved communications, New England developments have perhaps most to teach Great Britain, and especially in regard to planned instead of piecemeal development. The Planning Boards in the

six States only date from 1935 and the six chairmen with an independent chairman and two co-opted citizens, make up the New England Planning Commission, which is assisted by consultants, a small staff of technical assistants, and an advisory committee of 546 members distributed throughout New England and representing all types of activities—housing, transport, town planning, industry, etc. This Committee does not meet as a whole.

Future of Air-Conditioning

IN the July number of *Water Works and Sewerage* the editor makes some timely comments on the future of air-conditioning. Apparently water supply managers have little definite information as to the probable demands on local water supply facilities that will be made in the near future. Another important problem that has to be considered is the question of sewerage facilities capable of handling the increased loading to be imposed in the form of spent water discharged from the cooling equipment into sewers that have not been designed for this load. At the recent convention of the American Water Works Association some interesting data were given. During the year 1935-36, the air-conditioning capacity installed had increased 35½ per cent in Chicago. During the same period, the water sold to air-conditioned premises had increased 38 per cent. The figures also show that the peak demand for a district which is now only 16 per cent air-conditioned is 130 per cent above the daily average demand. In July and August also, the demands per 24 hours in the districts most densely air-conditioned reached 170 per cent of the annual average. The average over non-conditioned districts during the same two months was only 10 per cent. In a block of buildings containing theatres, hotels and restaurants all using air-conditioning the maximum per cent of the daily average was 250. Chicago is in the happy position that its major mains and pumping capacity seem sufficient for ten years more at this rate of growth. On the other hand, deficiencies of sewers will have to be made good, unless wasteful evaporative type cooling devices are installed in air-conditioning plant.

Earthing the Metal Sheathing of Electric Cables

A DIFFICULTY in connexion with electric supply when metal sheathing of electric wiring and apparatus is employed is how to connect this sheathing to earth in such a way that, in the event of it becoming electrified owing to a fault developing between the sheathing and a main, the faulty circuit may be disconnected at once and consequently the pressure between the sheathing and the earth cease to be dangerous. To secure this it is necessary that the sheathing be a continuous conductor of small resistance and that it is maintained in good electrical connexion with the earth. The Wiring Regulations of the Institution of Electrical Engineers stipulate that the electrical resistance of the metal sheathing or tubing must not exceed one ohm between any two points of its length. In practice this can easily be measured by testing. The connexion of this metal

sheathing to earth is more difficult to specify but in general it is stipulated that its resistance must not exceed one ohm. When it has this low resistance, the cut-out of the faulty main will act and so the sheathing and the metal in contact with it ceases to be dangerous. Where it is economically impracticable to obtain an earth having a resistance of not more than one ohm, earthing must be supplemented by an earth leakage 'trip-coil' so adjusted that it will operate at not more than 30 milliamperes. The resistance of an earth electrode depends very largely on the humidity and the character of the soil in which it is buried.

In many cases when the supply is taken from overhead mains and there is no water supply, compliance with the I.E.E. regulations is very difficult and practically impossible. In this case the neutral main of a four-wire system of supply gives an easy method of getting an approximate earth potential over the whole of the supply area. Where there are no parasitic currents from tramways, this system has many advantages. This system is used in some parts of Australia and New Zealand. The Electricity Commissioners and the Postmaster-General have given their special consent to its use in certain districts in Great Britain. When this system is adopted, no fuse must be inserted in any conductor connected with the neutral main. This leads to a simplification and consequent cheapening of electrical installation work. In Australia, the State Electricity Commission of Victoria has recently altered its wiring regulations. The provision of an automatic circuit breaker is made compulsory in all new installations. In addition, breakers have to be installed in all existing installations at the expense of the supply authority. It will be interesting to see how this works in practice.

The Enforcement of the Rules of the Road

SUGGESTIONS made by Dr. H. C. Dickinson, the chairman of the Highway Research Board of the U.S.A., are the subject of a recent report issued by Science Service. Traffic experts to-day are aiming at simplifying the traffic rules and reducing their number so far as possible. Dr. Dickinson has reduced them to four. The first is to keep to your own lane of traffic with only two thoughts in mind, namely, to watch the car ahead and to warn the car behind you whenever you do anything which changes your movement in your own traffic lane. Secondly, to realize that you have no right to cross or turn into another traffic lane. Thirdly, to give a clear signal, or indicate by the motion of your car, whenever you change from your own traffic lane. Finally, never exceed a speed at which the car cannot be stopped without interfering with other traffic in the lane. When an accident causes personal injury or damage to a car—other than fenders or bumpers—it should be obligatory for both parties to attend the action in court. In personal injury cases, the permits of all the drivers involved should be suspended pending the hearing, and the permit of innocent drivers, if any, could

then be restored. Dr. Dickinson makes the novel suggestion that when an accident has nearly occurred and has only been prevented by the quick-wittedness of one of the actors, regulations should be used which would enable 'enforcing' officers to issue 'tickets' to drivers endangering other drivers or pedestrians. The charge he suggests is that of 'creating a public danger', and the penalty a small fine or dismissal on probation. Repeated offences could be dealt with more severely. The object of the proposal is to make it very unpleasant for anyone who puts another person in jeopardy even although no harm results.

Zoological Types in India

THE series of "Indian Zoological Memoirs" has been enriched by an excellent monograph, illustrated by 65 text figures, on "Palæmon, the Indian River Prawn", by Dr. S. S. Patwardhan (Pp. xi+100. (Lucknow: Lucknow Publishing House, 1937.) 2 rupees). These monographs are intended to assist in the teaching of zoology in India by the selection of a number of readily obtainable types, which can be worked out fully by students in their own time and perhaps at their homes. A single animal studied closely in respect to its anatomy with the consequent consideration of the function of all its parts is bound to be of great help. To this is added, in the judicious selection of types here, the possibility for the student to study his forms in Nature. The illustrations are good black and white drawings in close proximity to the descriptions of the parts, and there are directions for the necessary dissections. If we are to make any suggestions, we would plead for a greater consideration of function, and references might be inserted freely, so that interested students may be induced to examine their types in a more intelligent manner. For example, in this prawn a consideration of the mode of action of the mouth appendages may be deemed essential to the study of their anatomy—and we find no references to the considerable bulk of recent work on this matter. Form and function are inseparables, and both are essential to the study of the living animal. For a young student, the author assumes a little too much, the monograph being more useful to his teacher.

Institution of Professional Civil Servants

THE eighteenth annual report of the Council of the Institution of Professional Civil Servants covers the year 1936 and refers to a large increase in membership, which was 50 per cent greater than in 1935, when the figure of 10,000 was reached for the first time. One of the outstanding achievements of the year was the successful prosecution of salary claims on behalf of architectural and civil engineering and mechanical and electrical drawing office staffs. The satisfactory settlements which were reached are attributed largely to the extensive research of the Committee, which proved that such staffs were underpaid in comparison with similar employees outside. The report again emphasizes the importance of the National Whitley Council to members of the Institution. The

Council has also been concerned with the completion of the application of the recommendations of the Carpenter report to scientific establishments, and in his presidential address at the annual meeting on April 29, Sir Richard Redmayne emphasized the necessity for the upgrading of the highest professional and scientific posts in the Civil Service, which, so far as remuneration is concerned, compare most unfavourably with posts carrying a similar responsibility outside the Service. A sub-committee is considering appropriate salaries for those professional posts outside the scope of arbitration with the view of making representations to the authorities. The Association is also dealing with the salaries of architects, engineers and surveyors in the Civil Service. Sir Richard criticized the Treasury for refusing to allow the reference to arbitration of the Institution's claim that women scientific officers should receive the same scales of pay as their male colleagues in the same grade, and stated that the Chancellor of the Exchequer had been asked to receive a deputation on this question.

Fruit Supplies in 1936

THE Intelligence Branch of the Imperial Economic Committee has issued a volume dealing with fruit supplies during 1936 (H.M. Stationery Office, pp. 106. 2s. 6d. net or 2s. 9d. post free). 55 per cent of the total import of fruit was of Empire origin. So high a proportion has never before been reached. There are, however, some very potent lessons for the home producer. The present report gives the convincing information that each apple tree yielded an average of 12.7 lb. of fruit in 1935, and 68.3 lb. in 1936. The "untimely and unusually severe frost" in May of 1935 is mentioned as the main cause of that season's low yield. It cannot be emphasized too strongly that the effects of frost are now largely within the control of the grower. The pioneer work of Mr. George Harrington, the investigations into general principles by various scientific workers, and the practical experiments by the technical staff of Messrs. Geo. Monro, Ltd., have made the practice of orchard heating a practical proposition without heavy finance. Total imports of raw fruit into the United Kingdom remain fairly steady around an average of nearly 28,000,000 cwt., and apple imports are not very variable around a mean of about 6,500,000 cwt. Imports of grapes, peaches, lemons, pineapples and plums from Empire sources were higher in 1936 than ever before, and more bananas were imported by Great Britain than in any previous year. Supplies of fruit from South Africa reached a new record. Totals for most fruit imports were, however, lighter than in 1935.

The Ross Institute

A MEETING of the Industrial Advisory Committee of the Ross Institute, which is now incorporated with the London School of Hygiene and Tropical Medicine, was held on May 28, at which the activities of the Institute were surveyed. Useful discussions also ensued upon the housing of African labour, the

risk of malaria when replanting rubber, the Indore process of disposal of night soil and town refuse and courses of instruction for laymen proceeding to the tropics. Information was also given of an investigation by Dr. Crowden at the School of Hygiene of experiments on air-conditioned cubicles for use in the tropics.

Fast Atlantic Crossing by Air

THE Empire flying-boat *Cambria* crossed the Atlantic on September 28 in the fastest time ever recorded. The distance of 2,000 miles from Newfoundland to Foynes, near Limerick, was covered in 10 hr. 36 min., giving an average speed of 190 miles an hour. According to the account in *The Times* of September 29, Captain G. J. Powell made tests of speed at various altitudes. During the first part of the flight he remained at 4,000-5,000 ft. and made speeds of 172.6-185 m.p.h. Later he climbed to 7,000 ft. and attained a speed of 195 m.p.h. Bad weather then forced him to 13,000 ft. when his speed fell to 167 m.p.h. Eventually, he reduced the height to 10,000 ft., where the most favourable wind for the easterly part of the journey was found.

The Night Sky in October

SUMMER Time ends on October 3 at 2^h U.T. The moon is new on October 4 at 12.0^h and full (the Hunter's Moon) on October 19 at 21.8^h. Conjunctions between the moon and the planets occur as follows: Venus on October 2 at 4^h; Mercury on October 3 at 6^h; Mars on October 11 at 18^h; Jupiter on October 12 at 17^h and Saturn on October 18 at 8^h. On October 29 at 17^h, Mars and Jupiter are in conjunction; the two planets passing within 1½° of one another (heliocentric positions). On October 11 at 6^h, Venus is in conjunction with Neptune. On October 15, Uranus is near the sixth magnitude star α Arietis; the diameter of the planet is 3½". The satellites of Jupiter, which always offer an attractive field for observation, present a few special features this month. On October 5 at 2^h 24^m-27^m Satellite II will be partly eclipsed by Satellite I. On October 7 a similar eclipse of these two satellites takes place at 22^h 07^m-24^m, the magnitude of the eclipse being 0.4. On October 17, I is partially eclipsed by III at 3^h 27^m-36^m. Appulses between II and I occur on October 12^d 01.9^h and October 22^d 1.0^h, whilst a complete occultation of II by I will take place on October 25^d 17.9^m. On October 13, Jupiter will occult the seventh magnitude star *B.D.* -22° 5100 = *C.D.* 13939, the emersion being visible in Great Britain at 18^h 34^m at position angle 276° from the north point of the planet's image ("B.A.A. Handbook, 1937", p. 19). The light variation of Algol (β Persei) may be observed about 1½ hours before and after the following times: October 3^d 19.6^h; 18^d 03.7^h; 21^d 00.5^h and 23^d 21.3^h. The periodic comet, Encke, which was re-discovered by Jeffers on September 3 at the Lick Observatory, passes from Triangulum to Andromeda during the month. The comet, which was of magnitude 18 at the time of discovery, is still very

faint, its anticipated magnitude at perihelion on December 27 being about 5.5. An ephemeris for this comet is given by Dr. A. C. D. Crommelin in "B.A.A. Handbook", p. 34; corrections to this ephemeris are given by L. E. Cunningham, using the positions obtained by Jeffers at re-discovery. The zodiacal light may be seen before dawn in the first part of the month when the moon is absent. In view of the present general high level of solar activity, the northern skies may also be scanned for the presence of auroral light.

Announcements

H.M. QUEEN MARY has once again shown the keen interest she takes in the higher education of women by promising to visit the Royal Holloway College (University of London) at Egham on October 12. H.R.H. Princess Alice is chairman of the governors of this women's College, which has about two hundred students, and she shows a highly practical interest in the College and in the careers of its students. It is worthy of mention that during the university year just closing a student of Royal Holloway College, Miss Gladys E. Muddle, gained the Sherbrooke Studentship and the Sir John William Lubbock Memorial Prize, open to all students of mathematics in the University of London.

SIR THOMAS HOLLAND, principal of the University of Edinburgh, and formerly director of the Geological Survey of India, has accepted the presidency of the Geographical Association for 1938.

THE Le Chatelier Memorial Lecture of the Chemical Society will be delivered on October 28 at 5.30 p.m. by Dr. C. H. Desch, superintendent of the Metallurgical Department, National Physical Laboratory.

THE Sex Education Society has issued a programme of seven lectures to be given at the Conway Hall, Red Lion Square, W.C.1, during the present session. The first will be delivered by the president, Dr. Norman Haire, at 8 p.m. on October 5. The full programme can be obtained from the Honorary Secretary, 27 Harley Street, W.1.

THE Annual Conference of Greenkeepers will be held at St. Ives Research Station, Bingley, Yorkshire, on October 19. During the morning, a tour of the Research Station will be made, and during the afternoon a series of short papers will be given. A course on scientific greenkeeping will be held on October 20-26. The course will include non-technical lectures by members of the staff of the Research Station, coupled with practical work and demonstrations on the experiment ground. Further information can be obtained from the Director, St. Ives Research Station, Bingley.

THE British Drug Houses, Ltd., Graham Street, London, N.1, have issued a new edition of their

booklet dealing with B.D.H. standard stains, and including also a full range of the various materials required by the microscopist; the booklet may be obtained free on application. Useful notes are appended upon the bacteriological, histological and pathological applications of the various stains and materials, most of which can be supplied in small quantities suited to the requirements of the individual worker.

DR. S. C. BLACKTIN writes to point out that an error occurs in the short article contributed by Dr. J. S. Owens to NATURE of August 21 upon his "Electrotor Smoke and Dust Meter". The article was based solely upon a paper by Dr. Blacktin in the *Journal of Industrial Hygiene and Toxicology*, and not upon an examination of the instrument itself. Referring to the insertion of a new record disk, the words were used "and the cap with its disk screwed into position". Dr. Blacktin points out that this was a misunderstanding of the statement made in his paper; for the record disk is not supported inside the cap of the instrument but on a table under it.

THE Academy of Sciences of Cuba has recently celebrated the seventy-fifth anniversary of its foundation.

A CHAIR of social medicine has recently been created in the University of Paris. Its incumbent will initiate fifth-year students into certain elements of preventive medicine such as sickness insurance.

DR. JOHN E. GORDON, field director of the International Health Division of the Rockefeller Foundation, New York, has been appointed professor of preventive medicine and epidemiology at Harvard University Medical School.

THE John and Mary R. Markle Foundation of New York has presented one hundred thousand dollars to the National Research Council for the support of research in endocrinology in the next three years. The fund will be administered by the Division of Medical Sciences.

As the result of years of agitation by social reformers, no marriage will be possible in the Argentine in future unless the bridegroom is able to present to the civil authorities a certificate that he is free from contagious diseases transmissible in wedlock. The law, which is to be enforced immediately, does not apply to women. Other clauses in the law provide for the compulsory hospitalization of refractory cases of contagious infection and the closing of houses of ill-fame.

ERRATUM. In the obituary notice of Prof. H. E. Armstrong in NATURE of July 24, on p. 140, col. 1, lines 17 and 18 from bottom, for "Sir George Grove" read "Sir William R. Grove".

Letters to the Editor

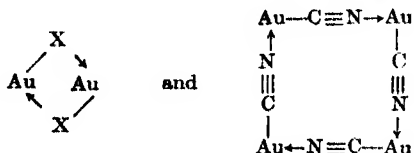
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 590.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

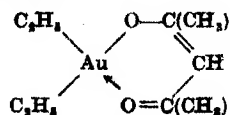
Constitution of Aurous Compounds: Gold Mirrors

THE volatile aurous compounds described by Dr. F. G. Mann and Dr. A. F. Wells¹ provide further examples of the fact that, in its aurous compounds, gold is always 2-covalent. Constitutionally analogous sulphur and nitrogen compounds are also known. It is significant that whenever gold is in solution in the aurous condition, the metal is always present in a complex ion. This is shown in the cases of such typical compounds as potassium aurocyanide, $\text{KAu}(\text{CN})_2$, and hydrobromaurous acid, HAuBr_2 . Like the auric ion, the aurous ion appears to be incapable of existence, and some investigations² have shown that the probable constitutions of the aurous halides and of aurous cyanide are respectively:



Thus, even in its simplest compounds, aurous gold appears always to be 2-covalent, while auric gold is always 4-covalent and the four valencies are coplanar with the gold atom³.

The production of gold mirrors by the heat decomposition of gold compounds is, of course, not new. Faraday in 1856 showed that drops of "gold chloride" solution evaporated in watch glasses and heated over a spirit lamp produced films which exhibited by transmitted light the same colours as the gold-containing liquids (Chemistry Exhibit, 157, Science Museum). In 1930, brilliant mirrors or films of pure gold were produced by gently heating the volatile tervalent and 4-covalent gold compound, diethylgoldacetylacetonate⁴:



Some of the first pure gold films produced at ordinary temperatures by the process recently described⁵ can be seen in the gold exhibit in the South African Court of the Imperial Institute.

CHARLES S. GIBSON.

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Guy's Hospital Medical School,
London, S.E.1.
Sept. 20.

¹ NATURE, 140, 502 (Sept. 18, 1937).

² J. Chem. Soc., 880 (1934); 219, 1024 (1935).

³ Cox and Webster, J. Chem. Soc., 1635 (1936). Gibson and co-workers, forthcoming publication.

⁴ Gibson and Simonsen, J. Chem. Soc., 2532 (1930).

⁵ NATURE, 140, 279 (Aug. 14, 1937).

Structure of Organic Molecular Compounds

THREE general conceptions are current as to the nature of the valence forces responsible for the formation of organic molecular compounds, each of which may conceivably be true as the limiting case in certain classes of compound:

(a) The molecular compounds are merely lattice compounds, involving no genuine chemical bonding, but depending for their formation and composition upon considerations of packing. This probably applies to such compounds¹ as $\text{CHI}_3 \cdot 3\text{S}_8$.

(b) Combination occurs by the formation of true co-ordinate links, as in inorganic molecular compounds. This view has been developed, probably incorrectly, in connexion with the polynitrobenzene-hydrocarbon compounds².

(c) Union is effected by the forces of interaction between strongly polar groups and the highly anisotropic, polarizable aromatic systems³. The London forces thus involved are, in a sense, intermediate between van der Waals's attractions and true covalencies.

During the past few months, an X-ray examination has been made of the quinhydrones and related compounds, with the view of eliciting the evidence of crystal structure as to their constitution. A similar approach to the nitrobenzene-hydrocarbon compounds was made by Hertel⁴, without conclusive results. The full results of the present investigation will shortly be presented elsewhere, but the following morphotropic considerations appear to lead the problem nearer to a solution.

(1) The discrete existence of quinonoid and quinoloid units in the structure, necessitated by the revised quinhydrone structure of Palacios and Foz⁵, is confirmed.

(2) The identity of the *a* and *b* dimensions in ordinary quinhydrone and in α -naphthoquinone quinhydrone (see table) show that the quinone and quinol groupings lie essentially in the (001) plane, with the breadth of the molecules along *c*, as was advanced for quinhydrone⁶.

(3) For dimensional reasons, the quinone and quinol units can alternate only along the *a* and *c* directions, but not along *b*. The formation of quinhydrone by a species of infinite hydrogen bond polymerization⁷, which, from the orientation of the molecules, could only take place along *b*, is thereby excluded.

(4) In phenoquinone, $\text{C}_6\text{H}_4\text{O}_2 \cdot 2\text{C}_6\text{H}_5\text{OH}$, *b* and *c* are essentially unchanged, whereas *a* is exactly 3/2 times the *a* dimension of quinhydrone. Clear evidence is thus afforded that the components alternate along *a*. In various *p*-substituted phenoquinones, *a* and *c* are also slightly modified (due to the bulk of the substituents and to the inclination of the molecules to (001)) while retaining the same essential characteristics.

(5) The relation of the remarkably stable compounds of chloranil and bromanil with hexamethylbenzene, etc.—for example, $C_6Br_4O_2.C_6(CH_3)_6$ —to the quinhydrones⁷ is confirmed. The same alternation of components along a is observed, with identical a spacing; this brings the planes of the bromanil and the hexamethylbenzene molecules practically into contact. In these compounds there can scarcely be any question either of hydrogen bonds or of the formation of co-ordinate links.

(6) The direction of maximum light absorption in the quinhydrones and both the maximum of light absorption and the slow vibrational direction in the even more strongly pleochroic bromanil-hexamethylbenzene compound coincide with a .

	a	b	c	β	n	Space group
Quinhydrone	7.70	6.04	21.8	90°	4	C_{2h}^2
$C_{10}H_6O_2.C_6H_4(OH)_2$	7.70	6.16	27.4	Rhombic	4	V^4
$C_6Br_4O_2.C_6(CH_3)_6$	7.40	8.83	28.7	Rhombic	4	V^4
$C_6H_4O_2.2C_6H_5OH$	11.50	6.16	22.2	100°	4	C_{2h}^2
$C_6H_4O_2.2CH_3C_6H_4OH$	11.83	6.2	24.6	97°	4	C_{2h}^2
$C_6H_4O_2.2Br.C_6H_5OH$	12.16	6.16	24.3	96°	4	C_{2h}^2
$C_6H_4O_2.2Cl.C_6H_5OH$	12.00	6.16	23.5	97°	4	C_{2h}^2

Along this direction the aromatic molecules are stacked plane to plane at a perpendicular distance of the order of 3 Å. The trend of the evidence makes the conclusion inevitable that this represents also the direction of bonding, in which case the mechanism (c) is the most probable. The formation of hydrogen bonds in quinhydrone is not necessarily excluded, and their presence is now being sought by the elegant method of Robertson and Ubbelohde⁸.

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⁷ Hernal, *Trans. Faraday Soc.*, **28**, 211 (1930).

⁸ Bennett and Willis, *J. Chem. Soc.*, 256 (1929).

⁹ cf. Briegleb, *Z. phys. Chem.*, B, **26**, 63 (1934).

¹⁰ Hertel, *Z. phys. Chem.*, B, **11**, 59, 77 (1930); **22**, 280 (1933).

¹¹ *Anal. Fis. Quim.*, **30**, 421 (1932); **38**, 627 (1935).

¹² cf. Chem. Soc., Annual Reports, **30**, 420 (1933).

¹³ Pfeiffer, *Ann.*, **404**, 1 (1914).

¹⁴ NATURE, **129**, 504 (1937).

Duality of the Coproporphyrins in Bovine Congenital Porphyrinuria

Of the four theoretically possible isomeric types of porphyrins, only those belonging to Series I and III have so far been encountered in Nature. Hæmoglobin, bilirubin, cytochrome, etc., are Series III derivatives. Series III has thus come to be regarded as the normal or 'physiological' type. Excretion of excessive amounts of porphyrins belonging to Series III does, however, occur in certain pathological states including lead poisoning (Grotepass¹, Mertens², Fischer and Duesberg³), pigment cirrhosis of the liver (Dobrinier⁴), hepatic tumours (Dobrinier⁴) and after administration of salvarsan (Schreus⁵). The uroporphyrin excreted in acute idiopathic porphyria has been shown to be uroporphyrin III (Waldenström⁶, Mertens⁷), whilst Dobrinier⁸ has detected the simultaneous presence of coproporphyrins I and III in the stool from one such case.

The pigments formed in excessive amount by congenital porphyria were until recently thought to

belong exclusively to Series I, but Fischer and Hofmann^{9,10}, working with material from the human case 'Petty', and Rimington^{11,12} studying congenital porphyria in bovines, have shown that small quantities of uroporphyrin III accompany uroporphyrin I in this disease.

We have now been able to isolate coproporphyrin III from the urinary and faecal coproporphyrin mixture of the same bovines, thus extending the duality also to the coproporphyrins. Evidence strongly suggestive of the presence of coproporphyrin III in small amounts in the bile porphyrins of a previous bovine case had already been obtained chromatographically by Rimington¹¹, but the quantities available were insufficient to allow of crystallization.

In the present instance, the total coproporphyrin fraction (faeces or urine) was esterified and the more soluble coproporphyrin III methyl ester extracted by stirring with cold methyl alcohol (compare Dobrinier⁸; we are indebted to Dr. E. Mertens for privately suggesting this technique). After several repetitions of this procedure, the Series III ester was dissolved in a few drops of dioxane, a little methyl alcohol added and then sufficient water, drop by drop, to render the mixture slightly opalescent. On standing in the ice-chest, the porphyrin was deposited in micro-crystalline form, m.p. 138/172° (Fig. 1). Synthetic coproporphyrin III methyl ester (the gift of Prof. H. Fischer, whom we wish to thank), crystallized in the same way, had m.p. 140°. Mixed m.p. 138°. Spectrum of ester in ether: 625.3; 599.3; 587.5–566.7; 531.6; 498.7. Three different preparations were made.



Fig. 1.

COPROPORPHYRIN III FROM URINE: BOVINE CONGENITAL PORPHYRIA. \times ABOUT 100.

The occurrence of Series III porphyrins together with those of Series I in congenital porphyria may be traceable to a secondary toxic effect (Fischer and Hofmann¹⁰), but is equally readily explicable on the basis of the scheme put forward by Rimington^{11,12} picturing a catalysed synthetic mechanism in the hæmatopoietic tissue.

We have also encountered another pigment in these urines which we believe to be a hitherto

undescribed porphyrin. The methyl ester crystallizes in rectangular or rhomboidal prisms, resembling protoporphyrin ester, has m.p. 233–38° and a spectrum closely similar to that of coproporphyrin. The quantity obtained is as yet insufficient for analysis.

CLAUDE RIMINGTON.
G. C. S. ROETS.

Onderstepoort Veterinary Research Laboratory,
Pretoria, S. Africa.
Aug. 22.

¹ Grottepass, *Z. physiol. Chem.*, **205**, 193 (1932).

² Mertens, *Klin. Woch.*, **18**, 61 (1937).

³ Fischer and Duesberg, *Archiv. exp. Path. Pharm.*, **106**, 95 (1932).

⁴ Dobriner, *J. Biol. Chem.*, **113**, 1 (1936).

⁵ Schrens, *Klin. Woch.*, **14**, 1717 (1935).

⁶ Waldenström, *Deut. Archiv. Klin. Med.*, **178**, 38 (1935).

⁷ Mertens, *Z. physiol. Chem.*, **238**, 1 (1936).

⁸ Dobriner, *Proc. Soc. Expt. Biol. Med.*, **35**, 175 (1936).

⁹ Fischer and Libowitzky, *Z. physiol. Chem.*, **241**, 220 (1936).

¹⁰ Fischer and Hofmann, *Z. physiol. Chem.*, **246**, 15 (1937).

¹¹ Rimington, *Onderstepoort J. Vet. Sci.*, **7**, 567 (1936).

¹² Rimington, *NATURE*, **140**, 165 (1937).

¹³ Rimington, forthcoming publication in *Comptes Rendus Trav. Lab. Carlsberg: Sørensen Festschrift*.

Disintegration Processes by Cosmic Rays with the Simultaneous Emission of Several Heavy Particles

On photographic plates which had been exposed to cosmic radiation on the Hafelekar (2,300 m. above sea-level) near Innsbruck for five months, we found, apart from the very long tracks (up to 1,200 cm. in length) which have been reported recently in a note in the Wiener Akademie-Berichte, evidence of several processes described below.

From a single point within the emulsion several tracks, some of them having a considerable length, take their departure. We observed four cases with three particles, four with four and 'stars' with six, seven, eight and nine particles, one of each kind.

The longest track corresponded to a range in air (15°, 760 mm. Hg) of 176 cm. The ionization produced by the particles is different in the different cases. Most of the tracks show much larger mean grain-distances than α -particles and slow protons.

In Fig. 1 a 'star' with eight tracks is reproduced. On account of the rather steep angles at which some of the particles cross the emulsion-layer (approximately 70 μ thick) it is not possible to have all the tracks of a 'star' in focus simultaneously. Fig. 2 shows a sketch of the same 'star'. Measurement of the tracks gives the results in the accompanying table.

Track	Length in cm. of air (15°, 760 mm.)	Number of grains	Position of the end of the track
A	30.0 cm.	113	Within the emulsion
B	11.0 "	15	" " "
C	44.0 "	71	Glass
D	6.2 "	11	"
E	7.0 "	22	"
F	1.2 "	5	Within the emulsion
G	18.6 "	67	Surface of the emulsion
H	23.0 "	58	Glass

Centre of the 'star' 25 μ under the surface of the emulsion.

We believe that the process in question is a disintegration of an atom in the emulsion (probably Ag or Br) by a cosmic ray. The striking feature

about it is the simultaneous emission of so many heavy particles with such long ranges, which excludes any confusion with 'stars' due to radioactive contamination. A similar configuration of tracks by chance is equally out of question. Brode and others¹

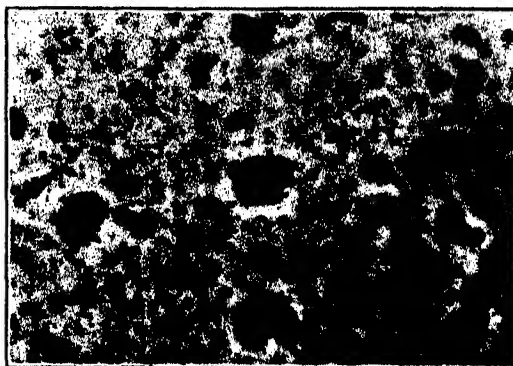


FIG. 1.

observed a single case of a disintegration with three heavy particles in a Wilson cloud chamber. The phenomenon which Wilkins believes was a shower of protons is perhaps a similar process, but he did not observe a centre².

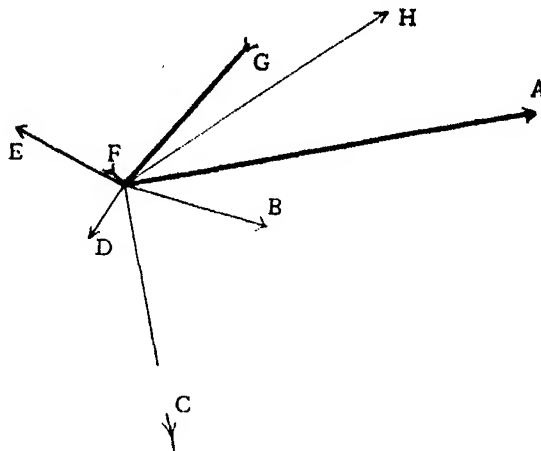


FIG. 2.

THICK LINES INDICATE A COMPARATIVELY LARGE NUMBER OF GRAINS PER UNIT OF LENGTH OF THE TRACK. AN INTERRUPTED LINE MEANS THAT THE TRACK IS TOO LONG TO BE REPRODUCED ON THE SAME SCALE. THE ARROWS INDICATE THE DIRECTION FROM THE SURFACE OF THE EMULSION TO THE GLASS.

The total energy involved in the process cannot as yet be calculated as most of the particles do not end in the emulsion.

We hope to give further details before long in the Wiener Akademie-Berichte.

M. BLAU.
H. WAMBACHER.

Radium Institut
u. 2 Physik. Institut,
Wien.
Aug. 25.

¹ Brode, R. L., and others, *Phys. Rev.*, **50**, 581 (October, 1936).

² Wilkins, *Nat. Geog. Soc., Stratosphere Series*, No. 2, 37 (1936).

Polarization of the Solar Corona

DURING the eclipse of June 19, 1936, at the observation station near the village of Kalenoe on the banks of the Ural River (U.S.S.R.), an investigation of the polarization of the solar corona was carried out by the expedition from Abastumani Observatory. The observations were made under perfect atmospheric conditions. A polarigraph with a reflecting analyser was used. The polarization was studied in two regions of the spectrum, corresponding to photographic and visual rays. In each series three plates were obtained with planes of polarization making angles of 60° . This enabled us to determine the degree and the direction of polarization at each point. On the plates the zone from $10'$ to $40'$ from the limb was found to be suitable for accurate photometric measurements. The effect of polarization is obvious.

From the study of the distribution of the degree and direction of the polarization, we can draw the following preliminary conclusions:

(1) The degree of polarization is different for different regions of the spectrum.

(2) The change of the polarization with increasing distance from the moon's limb is different for different heliographic latitudes, and depends on the structure of the corona. At places with a sharp radial structure (in corona streams) the polarization changes little, while between the streams it diminishes with the distance from the moon's limb.

(3) The direction of the polarization, while remaining approximately radial close to the solar poles and between streams, undergoes a strong but regular perturbation in the streams themselves.

The distribution of the direction of polarization in the outer corona (considering it as a vector) shows a certain analogy to the field of force.

K. G. ZAKHARIN.

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Aug. 28.

Anomalous Dielectric Constant of Artificial Ionosphere

SINCE the earliest experiments of Barton and Kilby¹ in 1913 on the dielectric properties of ionized air, there have been many attempts by investigators to record experimentally the depression of the dielectric constant of an artificial ionosphere (as the ionized air in a discharge tube may more properly be called) to a value less than unity. It has, however, been found by almost every investigator that the reduced value of the dielectric constant could be obtained only under very special experimental conditions such as low value of ionization in the experimental discharge tube or ultra-high frequency of the exciting wave; while, more often than not, the value of the dielectric constant recorded was greater than unity. This latter result is usually believed to be contradictory to the theory, and various explanations have been put forward to explain the apparent anomaly.

The purpose of this note is to show from a consideration of the ionospheric dispersion formula that the so-called anomaly is not an anomaly at all, since the formula itself yields values of the dielectric constant greater than, equal to, or less than unity, depending upon the experimental conditions of the discharge tube such as the degree of ionization, the

pressure (that is, collisional frequency) and the exciting wave frequency.

The complete dispersion formula is given by

$$\left(\mu - \frac{ic\kappa}{p}\right)^2 = 1 + \frac{1}{\alpha + i\beta} \quad (1)$$

Where $\alpha = -\frac{p^2 m}{4\pi N e^2}$ and $\beta = \frac{m p v}{4\pi N e^2}$.

The symbols have their usual significance.

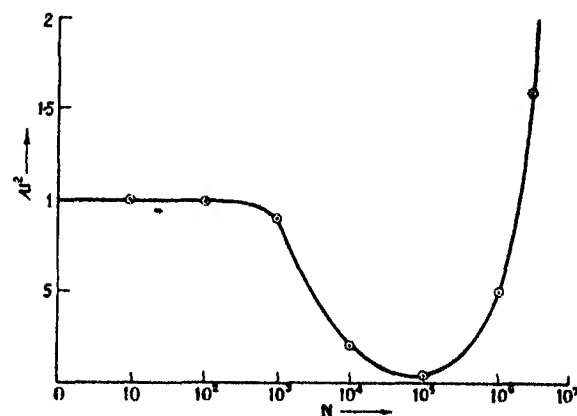


Fig. 1.

Separating the real and the imaginary parts, we have²

$$2\mu^2 = \sqrt{1 + \frac{2\alpha + 1}{\alpha^2 + \beta^2}} + \frac{\alpha}{\alpha^2 + \beta^2} + 1 \quad (2)$$

$$\frac{2c^2\kappa^2}{p^2} = \sqrt{1 + \frac{2\alpha + 1}{\alpha^2 + \beta^2}} - \frac{\alpha}{\alpha^2 + \beta^2} - 1 \quad (3)$$

It is easily seen from expressions (2) and (3) that μ^2 is greater than, equal to, or less than, unity, according as

$$\frac{|\alpha|}{\alpha^2 + \beta^2} < \frac{c^2\kappa^2}{p^2}$$

If $\alpha \gg \beta$, expression (2), reduces to

$$\mu^2 = 1 - \frac{4\pi N e^2}{m(p^2 + v^2)} \quad (4)$$

The approximate formula (4), which apparently suggests that μ^2 cannot attain a value greater than unity, has been responsible for the widespread belief "that the theoretical expression for the dielectric constant of an ionized medium does not permit values greater than unity, whatever the ionic concentration may be". Calculation of values of μ^2 from the complete dispersion formula shows, however, that the theoretical expression for the dielectric constant *does* permit values both greater, and less than, unity.

Figs. 1 and 2 are plots of equation (2). In Fig. 1, the dielectric constant is plotted against the ionic density N , all other quantities remaining constant. It is seen that only within a limited range of N can values of μ^2 less than unity be recorded. If N is increased beyond this range, the value of the dielectric constant increases and becomes greater than unity.

Fig. 2 is drawn for values of v , N and p as were obtained in an actual experiment by Mitra and Banerjee³. The broken line prolongation of the left-hand portion of the curve is obtained by using the approximate formula (4). Mitra and Banerjee had explained the upward swing of the curve to the right

by assuming the effect of conductivity in their experiment. It is now seen that the existence of this portion of the curve is implied in the complete dispersion formula (2). The expression under the square root contains terms which take into account the

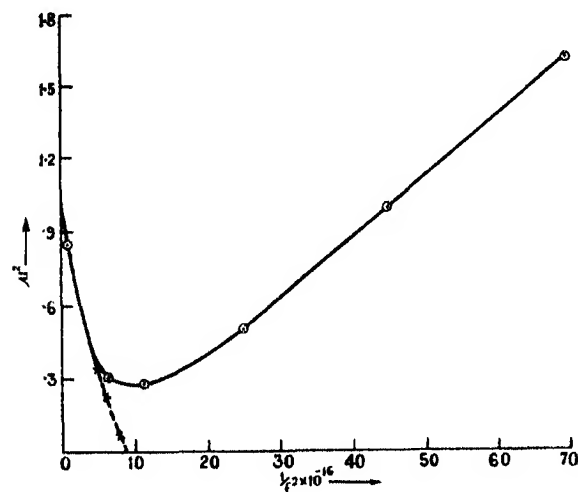


Fig. 2.

effect of conductivity. The fact that the experimental curve of Mitra and Banerjee, though similar in nature to Fig. 2, does not agree closely with it, shows that the disposition of the experimental apparatus had possibly some influence.

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Calcutta.
Aug. 16.

- ¹ Barton, E. H., and Kilby, W. B., *Phil. Mag.*, **26**, 567 (1913).
² White, F. W. G., "Electro-magnetic Waves" (Methuen and Co., 1934), p. 58.
³ Appleton, E. V., and Chapman, F. W., *Proc. Phys. Soc.*, **44**, 253 (1932). (The remark quoted is for the case of no external magnetic field.)
⁴ Mitra, S. K., and Banerjee, S. S., *NATURE*, **139**, 512 (1935).

Effect of Near Lightning Discharges on a Magnetometer

DURING two thunderstorms at the beginning of the present monsoon, the recorded curves of the Copenhagen declination magnetograph recently installed at Alibag showed some characteristic features which on examination appear to be due to the effect of the magnetic field of the lightning discharge currents on the magnetometer. The magnetograms are reproduced in Fig. 1. The variations occurred between 2 hr. and 4 hr. and between 18 hr. and 22 hr. I.S.T. The storm was most intense in the second of the two intervals at about 20 hr. The magnetometer needle experienced a number of sudden kicks, and the subsequent oscillations gradually died down in 2-3 minutes. The maximum first deflection was about 1.5 mm.

It is easy to make a rough estimate of the deflection of the magnetometer needle that may be expected due to the magnetic field of a near lightning discharge. For impulsive discharges the total duration of which is small compared with the periods of the magnetometer, the instrument will behave as a ballistic galvanometer, the relation between the discharge current, its

duration, the constants of the suspended needle and the field in which it is suspended being given by the usual formula :

$$\int i dt = q = \frac{HT}{\pi G} \sin \frac{\theta}{2} \left(1 + \frac{\lambda}{2} \right),$$

if the magnetic field due to the current is perpendicular to H . In the present instance, T was 3.95 sec. and H was $\frac{0.376}{4.9}$ gauss. The effective magnetic field was smaller in the ratio 1:4.9 because, in order to increase the sensitiveness of the magnetometer, the north pole of the needle had been made to face south by applying torsion to the suspending quartz fibre

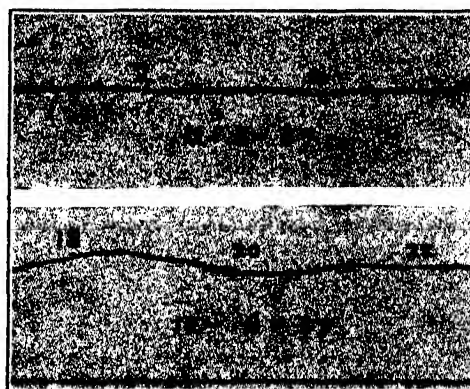


Fig. 1.

RECORDS OF A D. LA COUR DECLINATION MAGNETOGRAPH OBTAINED ON MAY 12, 1937, AT ALIBAG, NEAR BOMBAY, SHOWING THE EFFECT OF NEAR LIGHTNING DISCHARGES. THE TIMES ARE IN HOURS (INDIAN STANDARD TIME).

in the manner recommended by Dr. D. La Cour. Now G , the field at the needle (supposed short) due to unit current in the discharge circuit is given by

$$G = \frac{l \sin \theta}{r^2},$$

where l is the length of the discharge current, r its distance and θ the angle between r and the discharge path. The direction of the field is perpendicular to the plane containing l and the centre of the needle. Assuming $\sin \theta = 1$, $l = 2$ km. and $r = 2$ km., then $G = 5 \times 10^{-4}$. A probable value for q is 20 coulombs (see C. T. R. Wilson's article on Atmospheric Electricity in the "Dictionary of Applied Physics"). From these data the deflection of the needle can be easily calculated. It comes out to be $1/4820$ radian when the lightning discharge is most favourably oriented. The corresponding deflection on the chart when the distance of the photographic paper from the mirror of the magnetometer is 165 cm. is $2 \times 165/4820$ cm. or 0.7 mm. The observed and expected deflections are of similar magnitudes.

Attempts are being made to design a simple magnetometer with a Helmholtz compensating coil for the purpose of measuring the discharges of individual lightning flashes.

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Bombay.
Aug. 6.

Sensitization of the Skin of Mice to Light by Carcinogenic Agents

WHITE mice painted twice a week for three weeks with benzpyrene in benzene are found to be sensitized to light. The mouse is painted and exposed to direct sunlight for a half to one hour; during the exposure the skin of the painted area becomes red and markedly oedematous. There is no latent period to this reaction; within a few minutes of the exposure the mouse becomes ill at ease, scratches the painted region and tries to hide it from the sun. The next day, the area shows a definite dermatitis.

Unpainted white mice having the hair closely clipped over the same region showed no reaction after three hours' exposure or at any subsequent time; unpainted areas in the experimental mice gave no reaction, nor did mice painted with the solvent.

Exposures to infra-red radiations and to ultra-violet radiations did not give rise to these reactions. By dividing the visible spectrum into three with Kodak gelatine filters, it was found that only the blue-violet light was effective: this corresponds with the absorption spectrum of benzpyrene.

Similar reactions have been obtained with tar and with di-benzanthracene, but which part of the spectrum is responsible has not yet been ascertained.

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Sept. 14.

I. DONIACH.
J. C. MOTTRAM.

Gonadotropic Activity of Amphibian Anterior Pituitary

PREVIOUS attempts, using infantile mice or rats as test animals, to demonstrate the presence of a gonadotropic substance in the anterior pituitary of frogs have been entirely negative¹. Since implantation of frog's pituitary into frogs causes ovulation, Zondek comes to the conclusion that the frog's pituitary contains a gonadotropic substance which is inactive in warm-blooded animals. The negative results obtained by Lipschutz and Pacz and Zondek were probably due to the fact that the amount of pituitary tissue implanted was too small. Adams and Tukey, however, injected saline suspensions of from 16 to 96 frogs' pituitaries into each infantile mouse and still obtained negative results.

In view of the interest of this work from the point of view of comparative endocrinology, similar experiments were performed using *Xenopus laevis*, the South African clawed frog, as donor. Littermate female white mice 19-22 days old were used as recipients. In each experimental series one or two animals received a subcutaneous implant of frog anterior pituitary tissue; two to four mice received control implants of one of the following frog organs: brain, kidney, muscle, spleen, liver, ovary; one to three animals served as normal untreated controls. 72 hours later the mice were examined for opening of the vagina. They were then killed and the ovaries and uteri removed. The ovaries were dissected away from their oviducts and capsules. Fat and loose connective tissue were carefully removed from the uteri. All organs were immediately weighed on a torsion balance.

Implantation of 3.5 mgm. of anterior pituitary caused opening of the vagina but had no effect on the weights of either ovaries or uterus. Implantation of 8-20 mgm. caused opening of the vagina in all but two of twelve animals, also an increase in the weight of the ovaries and a two- to fourfold increase in uterine weight. In two mice haemorrhagic follicles (*blutpunkte*) were present in both ovaries; the uteri

weighed 31.0 mgm. and 32.5 mgm. (controls, 8 mgm.) and the ovaries 4 mgm. and 5 mgm. (controls, 2 mgm.). In seven animals uterine weights of 17-23 mgm. were obtained. All control implants gave negative results. A few of the enlarged ovaries were sectioned and showed definite follicular growth.

The ovarian, uterine and vaginal responses obtained in these experiments provide definite evidence that the gonadotropic substance of amphibian anterior pituitary can activate the mammalian reproductive apparatus.

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Aug. 24.

H. ZWARENSTEIN.

¹ Lipschutz, A., and Pacz, E., *Compt. rend. Soc. biol.*, **99**, 693 (1928). Zondek, B., *Arch. Gynäk.*, **144**, 133 (1930). Adams, A. E., and Tukey, G. E., *Anat. Rec.*, **67**, Supp. 2 (1937).

Vitamin P

ACCORDING to Bentsáth and Szent-Györgyi¹, their experiments on the influence of vitamin P on the course of development of experimental scurvy² have been repeated at their request in several laboratories with the result that their observations were partly corroborated and partly not confirmed. This, they assert, is due to the fact that vitamin P requires for its activity the presence of traces of ascorbic acid.

In view of the fact that I repeated the above work independently, it is of interest to compare my results³ with the above. I was unable to record any vitamin P activity with daily doses of 1 mgm. of either 'citrin', hesperidin or a mixture of hesperidin and eriodictyol. When, however, sub-optimal preventive doses (0.1 mgm. and 0.2 mgm. of L-ascorbic acid a day) were administered alone to the experimental animals, a clinical and pathological condition was produced which resembled that obtained by Szent-Györgyi and his collaborators after the administration of vitamin P. This condition has always been known to occur when antiscorbutic doses lower than the minimum prophylactic dose have been offered to guinea pigs on well-balanced scorbutic diets, including the Sherman-La Mer-Campbell diet, which Bentsáth, St. Ruznyák and Szent-Györgyi used in their original investigation.

According to Bentsáth and Szent-Györgyi's latest view¹, one is driven to the conclusion that the basal diet I used (bran, barley meal, middlings, fish meal, crushed oats and autoclaved milk) contained no traces of ascorbic acid, which is undoubtedly true, but contained the hypothetical vitamin P, whilst the Sherman-La Mer-Campbell diet as used by them contained traces of ascorbic acid, although this is not evident from their negative control experiment², but no vitamin P; alternatively, the biological action observed by them was due to the contamination of their 'citrin', etc., with traces of ascorbic acid. The object of this note is to record the bearing of my results on the modified view of Szent-Györgyi and his collaborator, which was advanced since the appearance of my paper, in the hope that it will help in the solution of this elusive subject.

S. S. ZILVA.

Lister Institute of Preventive Medicine,
London, S.W.1.
Sept. 7.

¹ Bentsáth, A., and Szent-Györgyi, A., *NATURE*, **140**, 426 (Sept. 4, 1937).

² Bentsáth, A., St. Ruznyák and Szent-Györgyi, A., *NATURE*, **138**, 798 (1936).

³ Zilva, S. S., *Biochem. J.*, **31**, 915 (1937).

Meteorites: the Number of Pultusk Stones and the Spelling of "Widmanstätten Figures"

In criticizing others in *NATURE* of September 18 (p. 504), Prof. F. A. Paneth lays himself open to criticism. His calculation of the number of Pultusk stones is a remarkable example of what can be done with mathematics when all the factors are not taken into account. In 1868, Krantz supplied for the British Museum collection Pultusk stones weighing 3,545, 845, 793, 256 (half a stone), 139½ gm., and twelve others weighing together 243 gm. Towards the end of such a series it is the common practice to weigh the smaller stones together in one lot; and evidently the 212 (not 210) stones with an aggregate weight of 1 kgm. formed the tail-end of Krantz's stock. In 1908, Krantz was still offering Pultusk stones weighing 565, 492, 382 gm., and numerous others of less than 100 gm. While it is perfectly true that the best museums strive to acquire and preserve the best specimens, it is scarcely a balanced argument to quote, to the exclusion of these, a small private collection in Moravia, in which fragments of all the meteorites represented amounted to only 2 kgm.

In the British Museum collection there are 72 Pultusk stones with a total weight of 18,188 gm., the largest 9,095 gm. and the smallest 6 gm. (that is, less than the average in the Moravian collection); 264 in the Paris collection weigh 31,337 gm.; 175 in Chicago 14,291 gm.; 62 in Bonn 19,742 gm.; and 41 in Vienna 15,843 gm. These 614 stones account for half the total weight recovered. Individual stones of more than 1 kgm. in different collections (in addition to those in the British Museum) are 9,521, 8,070, 7,938, 7,150, 3,770, 2,500, 1,702, 1,040 and 1,025 gm. While it is not at all impossible or improbable that as many as 100,000 stones fell in this shower, the facts now available do not supply data for this to be proved mathematically.

In my paper in the *Mineralogical Magazine* in 1933 I collected fourteen variations in the spelling of "Widmanstätten figures" in the literature dating from 1813. Since then I have collected a few more. In the best books of reference the name of the discoverer is given as Widmanstetter (or Beckh-Widmanstetter). Prof. Paneth quotes the Austrian Biographical Lexicon, giving (from E. Cohen) the date and page, but not the volume (Teil 55), which suggests that he did not himself actually consult the original. Here the entry is under "Widmanstetter", and the same also in J. C. Poggendorff's "Biographisch-literarisches Handwörterbuch (1898, vol. 3). In the British Museum "Catalogue of Printed Books" a later member of the family, writing between 1870 and 1896, is catalogued under "Beckh-Widmanstetter" (Leopold von), with a cross-reference from Widmanstetter.

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Sept. 21.

Spiriform Morphology of some Lead Crystal Growths in Silica Gel

It has been well known since A. L. Simon's description of the phenomenon¹, that fern-like crystal growths of lead can be obtained in silicic acid gels containing lead acetate solution. Whereas Simon used zinc to promote the electrochemical liberation of metallic lead in the gel, the use of tin for the same

purpose leads to the formation of crystals of a strikingly different morphology and lustre.

Under conditions recently studied in detail, which are characteristically critical as regards the concentrations of the reactants (particularly the lead acetate) a spiriform type of growth has been observed, to which no previous reference can be found in the literature. These growths arise electrochemically in a way entirely different from those helical and spiral precipitates of lead iodide, lead chromate and calcium phosphate described in the published work of Hatschek and his pupils², neither do they resemble the silver chromate spiral precipitates described in Hedges's "Liesegang Phenomena", nor the spiral crystals of M. Copisarow³. These spiriform lead growths often take a form resembling somewhat a very deeply cut screw having a minute barrel diameter, and with a very serrated edge to the pitch; sometimes the growths are like a thin ribbon of lead, twisted into a spiriform strip. The accompanying photograph



Fig. 1.

(Fig. 1), for which I have to thank Mr. E. Rowell of the Kodak Research Laboratories, Harrow, reproduces a six by one inch test-tube containing two such spiriform specimens. Whilst a non-stereoscopic view of them cannot adequately indicate the full screw-like features, a cinematic record reveals on rotating the tube that the two spirals in it are respectively right- and left-handed. At the points where they touch the glass walls, the spirals flatten out into serrated strips and these curl strikingly in opposite senses.

In collaboration with Mr. A. King of the Chemistry Department of this College, with whom work on these phenomena is being continued, it has been found that those gels, which are 0.02 normal with respect to the lead acetate concentration, can be made to reproduce spiriform growths, whilst identical gels containing a slightly different concentration of lead will produce many other strikingly different growths; the use of metals other than zinc or tin will also promote further modifications in their morphology.

NORMAN STUART.

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South Kensington, S.W.7.
Aug. 23.

¹ *Koll.-Z.*, **12**, 171 (1913).

² *Koll.-Z.*, **27**, 225 (1920); *Biochem. J.*, **14**, 418 (1920).

³ *Koll.-Z.*, **47**, 60 (1929).

Judgment by Hypothesis

PROF. J. B. S. HALDANE (see *NATURE*, Sept. 4, p. 428), in comparing my attitude towards Prof. E. A. Milne's cosmology with that of Lysenko towards the Russian geneticists, draws an analogy which seems to me little short of fantastic. According to *NATURE* of August 21, Lysenko treats Darwin's words as dogmas by which to judge and condemn, without examination, the work of modern experimenters. I accused Prof. Milne of imitating the practice of the Aristotelians who treated Aristotle's

words as dogmas by which to judge and condemn, without examination, the work of their contemporary experimenters. If there is any analogy to be drawn, it is surely between Lysenko and the Aristotelians (ancient or modern).

However, I am less concerned with that than with the possible implication that I wish forcibly to restrict Prof. Milne's work. On the contrary, I would place freedom of thought and expression second only to complete dedication to truth (or truthfulness, for those who think they can dispense with the shorter word) in the list of essential conditions for research. While I wish with all my heart that Prof. Milne would stop inventing systems and telling us what God cannot do, and would return to those problems in astrophysics which he is so peculiarly gifted to solve, I would fight to the last ditch for his right to waste his talents if he so wishes. My complaint is that he does not satisfy the first condition. He deduces systems from pure fancy, but instead of consistently calling them products of the imagination and presenting them as works of art, he tacitly identifies them with the world of experience and calls them scientific. Mathematics, according to the phrase which has been repeated and disregarded *ad nauseam*, is a subject in which we do not know what we are talking about. If Prof. Milne would eliminate such words as time, nebula, universe . . . from his

papers, and substitute x , y , z throughout, I would no more seek to restrain his activities than I would those of the surrealists.

HERBERT DINGLE.

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London, S.W.7.
Sept. 15.

Tritium or Triterium?

I HOPE it is not too late to protest against the use of the name 'triterium' for the isotope of hydrogen of mass 3. The name appears in the very interesting article by Lord Rutherford in *NATURE* of p. 303, and has apparently been used elsewhere, to judge by the quotations in that article.

The word 'deuterium' is correctly formed from the Greek δευτερος (*deuteos*), 'second', but the Greek for 'third' is τριτος (*tritos*), not *triteros*. The name which corresponds properly with 'deuterium' is clearly 'tritium', and this word is already in use; for example, papers dealing with this isotope are indexed under 'tritium', and not 'triterium', in the indexes to the British Chemical Abstracts for 1935 and 1936.

KENNETH C. BAILEY.

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Dublin.
Sept. 1.

Points from Foregoing Letters

COMMENTING on a recent remark by Mann and Wells on the production of gold films by heat decomposition of volatile gold compounds, Prof. C. S. Gibson refers to previous experiments of the same type. Also, he points out that in aurous compounds gold is always 2-covalent and that aurous ions, like auric ions, are apparently incapable of existence.

A table with details of the structure of quinyhydrone and related compounds, as determined by X-ray analysis, is given by Dr. J. S. Anderson. The position of the quinone and quinol groupings, the relation of compounds of chloranil and bromanil to hexamethylbenzene and other structural characteristics are discussed.

A photomicrograph of coproporphyrin III, obtained from a bovine suffering from congenital porphyrinuria, is submitted by Dr. C. Rimington and G. C. S. Roets, showing that, as in the case of the related uroporphyrins, compounds belonging to both isomeric types (series I and series III) occur in certain pathological states.

Long-range ionization tracks, starting from a common focus in the emulsion of a photographic plate which had been exposed to cosmic radiation for five months at an altitude of 2,300 m., are considered by M. Blau and H. Wambacher to have been produced by disintegration of an atom in the emulsion by a cosmic ray.

Photographs of the solar corona, taken during the total solar eclipse of 1936 by means of a polarigraph with reflecting analyser, show, according to K. G. Zakharin, that the degree of polarization varies in different parts of the corona and also with the wavelength, and that the direction of polarization undergoes a change in the 'streams'.

Prof. S. K. Mitra and K. K. Roy point out that the complete formula for ionospheric dispersion yields

values for the dielectric constant which are greater than, equal to or less than unity, depending on degree of ionization, pressure and the exciting wave-length. The use of a simplified approximate formula had wrongly led to the opinion that theoretical considerations preclude values greater than unity, but such values were found experimentally.

Some characteristic fluctuations noticed in the declination magnetograms obtained at Alibag, near Bombay, are explained by Dr. K. R. Ramanathan as being due to the magnetic field of near lightning discharges. He points out that the magnetometer behaves as the needle of a ballistic galvanometer for these impulsive discharges, and suggests that this may be made the basis of an instrument for measuring the discharges of individual lightning flashes.

Implantations of the anterior pituitary of the frog into immature female white mice are found by Dr. H. Zwarenstein to activate the reproductive apparatus (opening the vagina, increase in weight of ovaries and uterus, and follicular growth).

Dr. S. S. Zilva observed no vitamin P activity on administering a daily dose of either 'citrin', hesperidin or a mixture of hesperidin and eriodictyol to guinea pigs on a scorbutic diet. He obtained, however, a biological response similar to that observed by Prof. A. Szent-Györgyi on administering sub-optimal doses of ascorbic acid. The bearing of these observations on Bentsáth and Szent-Györgyi's latest view concerning the action of vitamin P is pointed out.

ERRATUM.—In the note in *NATURE* of September 18, p. 509, referring to Dr. A. L. Reimann's communication, the statement: "the linear rate of decay of the phosphorescence of zinc-blende" should read: "the linear rate of decay of the *inverse* of the square root ($p^{-1/2}$) of the phosphorescence of zinc-blende".

Research Items

Eastern Himalayan Blood-Groups

IN view of the high percentage of Group *AB* found among Tibetans at Gyantse, Miss Eileen W. E. Macfarlane has obtained samples from Tibetans, Nepalis and Lepchas (*Man*, No. 159, August). The Tibetans were hospital patients and others at Kalimpong, North Bengal. The subjects either called themselves Bhutias or were Bhutanese. There are Bhutias in Sikkim State, who resemble the Tibetans physically and wear similar dress and ornaments. The Bhutanese were nearly all from Ha, Bhutan, and also belong to the Tibetan race. The sample in all numbered fifty-six. The proportion of the blood-groups differs considerably from the blood-groups observed by Tennant at Gyantse. The percentage of *B* is of the same order, and considerably lower than in the neighbourhood of Nepal. The percentage of *O* is much higher and of *A* lower than at Gyantse, the latter possibly being due to inbreeding, while the high proportion of *AB* may be a result of the Chinese garrison stationed there from the beginning of the century until 1912. The proportions found at Kalimpong suggest either that blood-group relationships differ markedly in different parts of Tibet, or that conditions in Gyantse are exceptional. One eighth of the Bhutias belong to Group *B*, more than a third to Group *A*, and almost one half to Group *O*, *AB* being rare. The preponderance of *O*, the characteristic group among American Indians, recalls the fact that the physical resemblances and similarities of artistic design between Tibetans and American Indians, especially the Navajos, has been noted as striking. The nearest Mongoloid neighbours of Tibet in China and Nepal are fairly high in *B* and it is remarkable that the Tibetans have absorbed relatively little of this group. They have evidently been isolated from the main stream of Mongolian migration since very early times.

Early Chinese Bronzes

AMONG a number of early Chinese bronzes from the Eumorfopoulos Collection, now in the British Museum (Bloomsbury), which are figured and described in the *Brit. Mus. Quarterly*, 11, 3, by Mr. R. S. Jenyns, is the famous ram-handled *tsun* which belongs either to the Shang-Yin, or early Chou Dynasty. This piece should convince sceptics that the Chinese bronzes of the classic period are equal, if not superior, to those of any other civilization. It is modelled in the form of two rams standing back to back, and is supported on four legs represented by their forefeet. From between their heads rises the funnel, which forms the mouth. The body is covered with scales, which may, or may not, have been engraved after casting. The conquest of Shang-Yin by the Chou princes about 1100 B.C. does not seem to have altered the Shang-Yin style. This *tsun* shows only one of the four innovations regarded by Karlgren as making their appearance at that period. It must, therefore, be very closely related to the Shang-Yin bronzes. It is difficult to account for the sudden appearance of the Shang-Yin culture, which produced highly complicated and distinctive bronzes without apparent effort. The mastery of technique and the conventionalized motives argue a long process of

evolution, and their inscriptions are far from primitive. Yet there is an enormous hiatus of time to be accounted for between the neolithic pottery from Western Kansu and Honan and these highly sophisticated vessels. The immediate ancestors of these are lacking. The Hsia culture, in which bronze casting and early forms of bronze must have made their appearance, remains a mystery. Even if it be admitted that bronze casting was introduced from the West in its finished form immediately before the Shang-Yin, the existence in Shang-Yin of forms evidently of great antiquity, which betray no affinity to known Western forms, is difficult to explain, without admitting a long process of internal evolution. We are compelled to believe that Shang-Yin culture had its roots in a distant past, but why almost no traces of that past have survived is a puzzle for which archaeology has yet to supply a happy solution.

Passerine Birds of Ethiopia and Kenya

DURING the months of its sojourn in Africa in 1911 and 1912, the Frick Expedition collected about 5,200 birds, besides a number of eggs and nests, and copious field observations, all due to the energy and collecting ability of the late Dr. Edgar Alexander Mearns. The description of the passerine birds by Herbert Friedmann adds to the faunal knowledge of an area remarkable for the wide range of its conditions, from desert to tropical rain-forest, from a rainfall of 0-11 inches to 70-80 inches, and from sea-level to 15,000 feet (*U.S. Nat. Mus., Bull.* 153, 479; 1937). Among the general features described is the marked tendency of far more lowland birds to range high up the mountain slopes in Ethiopia (to an altitude of 7,000-8,000 feet) than roach to about half that altitude (4,500 feet) in more equatorial portions of the continent. The authors regard the birds of these regions as having been derived from the steppes of south-eastern Asia by way of Asia Minor and Arabia during Pliocene times. In the course of this extensive movement many birds moved southwards through the area, such as the ancestors of *Francolinus sephaena*, *F. africanus*, *Streptopelia capicola*, *Lophoceros melanoleucus*; others remained and formed a centre in which new species developed, and from which westward migration probably contributed to the fauna of the western savannahs the ancestors of such forms as the ground hornbill (*Buceros abyssinicus*), the parakeet (*Psittacula krameri*), the roller (*Coracias abyssinicus*) and the chat (*Oenanthe bottae*).

Self-fertilization in Japanese Slugs

THAT a pulmonate mollusc may possess the power of laying fertile eggs when kept in strict isolation has been known since Oken's experiments on *Lymnaea auricularis* more than a century ago. A number of other species have since been shown to behave in similar manner. K. Ikeda (*J. Sci. Hiroshima University*, March 1937) has conducted extensive and carefully controlled investigations into this phenomenon in the slug, *Philomycus bilineatus*. The young hatched in spring do not become mature until autumn, so need not be isolated until then; they mate in autumn but the eggs are not laid until after awaking

from hibernation in spring. The discovery of albino forms allowed a certain amount of genetical analysis. The fertility of the egg results from self-fertilization and not from parthenogenesis, and the power of self-fertility does not diminish with age. The individual spermatozoa descend the genital duct to attain fertilizing power in the receptaculum seminis, and the varying degrees of self-fertility exhibited by different species possibly result from differences in the ability of the spermatozoa to migrate through the duct.

Larvæ of Indian Coleoptera

IN *Indian Forest Records*, 11, No. 9, Mr. J. C. M. Gardner, of the Forest Research Institute, Dehra Dun, continues his series of articles on the immature stages of Indian Coleoptera. The present contribution deals with various Carabidæ, or ground beetles, and includes descriptions of the larvæ of species belonging to eighteen genera of these insects. As a number of these genera are European, and the structural characters of their larvæ are figured, the paper is of interest to workers other than those studying the Indian fauna. Very little has been published previously on larvæ of the Indian members of the family, and the present article, it is hoped, will be followed by others of a like character.

Aquatic and Marsh Plants of India and Burma

MR. K. P. BISWAS described some aquatic and marsh plants of India and Burma in a paper read before Section K (Botany) at the meeting of the British Association on September 7. India and Burma contain an enormous stock of aquatic and marsh plants in their many stationary and flowing waters. The hill streams in the Himalayas have their beds often covered with *Batrachospermum* and *Sirodotia* sp. The coastline, both the Malabar and the Coromandal, harbour large quantities of different species of marine algae. But there is still a vast field for the investigation of the marine flora of the coastline of India and Burma. The Andaman Islands, the Mergui Archipelago have also a rich vegetation of marine algae, chiefly composed of *Caulerpa*, *Sargassum* and *Halimeda*. The estuarine areas are marked by dense mangrove vegetation exposed to tidal action. On the west coast *Ceriops Roxburghiana*, *Avecinia alba* are predominant. In the east, *A. officinalis*, *A. alba*, *Bruguiera gymnorrhiza*, *Rhizophora mucronata*, *Acanthus illicifolius*, *Agavecerus majus*, *Ceriops Roxburghiana* are dominant species. In the Sundribun down to Mergui Archipelago and farther south the two palms, *Phanix paludosa* and *Nipa fruticans* form quite a striking feature along the shore and deltaic areas. The larger rivers do not as a rule support much aquatic vegetation; but during hot months some portions of the beds of the rivers partially dry up, forming shallow pools separated from the main body of water. These pools form good culture beds of algae. Stationary water in the form of natural or artificial lakes, jhils, bils, tanks, pools, puddles and swampy areas (ricefield swamps) occupy a considerable area of the lower plains of the two countries. These, due to favourable edaphic and climatic conditions, are full of aquatic and marsh vegetation. In this mass of crowded vegetation, four zones can be distinguished: (1) the bottom layer, which may be called the zone of the vital layer; (2) the zone of rooted aquatics; (3) the zone of suspended vegetation, and (4) the zone of surface vegetation.

The inland brackish water plants are interesting, too. Such plants are often found in the plains of the cities near the sea, such as Bombay, Calcutta and Madras. The salt lakes of Calcutta retain a mixture of salt-water and freshwater vegetation in their swamps.

Polyporaceous Fungi

THE behaviour of nuclei in the developing basidium of the higher fungi has only been studied intensively during comparatively recent years. It has been generally established for one or two agaricaceous fungi that two nuclei fuse in the young basidium; the fusion nucleus divides, first by reduction division, and later by ordinary mitosis, to form the basidiospores. Dr. S. R. Bose adds welcome confirmation to this view, by showing that the Polyporaceæ possess a similar mechanism (*J. Ind. Bot. Soc.*, 16, No. 3, 119-128; 1937). Eleven species of Polyporaceæ have been studied, and results are given in detail for each species. Basidia are very small in the pore-bearing fungi, but a sufficient number of stages has been found to establish similarity of behaviour with other previously described Basidiomycetes. The mechanism of nuclear division is essentially similar to that of higher plants, though the chromosomes are too small to be counted satisfactorily. Dr. Bose has recently published a paper on "Polyporaceæ from Lokra Hills (Assam)" (*Ann. Mycologici*, 35, No. 2, 1937), in which he describes a number of species from an elevation of 5,000-10,000 feet. Many cosmopolitan fungi are included, and the accounts show that several polypores of temperate Europe and North America are found at this elevation in Assam, but are absent from the plains of Bengal. *Fomes fomentarius* is a typical example of such distribution.

A Dune Drainage System

MR. V. J. CHAPMAN has described an investigation made in 1933 to determine the nature of the water-table movements in the salt marshes of Soolt Head Island on the Norfolk coast (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, Session 1936-37). The area selected was especially convenient for the experiment as there is a small artificial pond near the centre, and it was the rise and fall of the water in this pond that prompted the investigation. The information obtained showed that while the diurnal tidal movements did not sensibly affect the level of the pond, it rose appreciably and rapidly about 48 hours after every maximum spring tide which reached a height of 27 ft. above Hull datum and then fell slowly. Particulars were also obtained showing the direction of the drainage flow. These water-table movements have a profound bearing on the plants which grow in the dunes and which, in order to tap the supply of fresh water known to float on top of the salt water, develop long roots. Without these periodic fluctuations of the water-table many of the dune plants would not be able to exist in summer when their need of water is great. To this extent, it is suggested, the flora of dune hollows may be associated with and dependent upon the subterranean water supply, assisted possibly by some capillary action in the sand. The conclusions reached as a result of this short investigation agree with those of earlier research carried out at Blakeney Point, and are therefore thought to be representative of the conditions in dunes in this part of Norfolk. These are that no flow takes place until the high spring tide reaches a

certain minimum level, that then a rapid rise takes place after a lag of 48 hours and that, except at these very high tides, the water drains out along the line of least resistance following a shingle path to the shore.

Meteorological Connexions between Greenland and Europe

At a meeting of the Royal Meteorological Society held on June 16, Dr. F. Loewe read a paper entitled "A Period of Warm Winters in Western Greenland and the Temperature See-Saw between Western Greenland and Central Europe". He referred to the studies of Grosse, Wagner and Scherhag on the marked change that has taken place in the climate of Greenland since about the beginning of the present century in the direction of milder winters and slightly warmer summers, resulting in a decrease of the mean annual range and therefore in a more oceanic climate. For example, the average difference between the extreme seasons from 1923-34 at Jakobshavn was 19.5°C . compared with 24°C . for the period 1876-1934. A striking individual instance of winter warmth is that of the period January-March 1929 when Jakobshavn temperature was 12.7°C . above the 1876-1935 mean, and the coldness of the same period in northern Germany (it was the coldest winter probably since 1830 and certainly since 1838) illustrates the see-saw of temperature with which the second part of the paper deals. This see-saw effect was pointed out by Hann so long ago as 1890, who observed that in the winter months the anomalies of temperature at Vienna and Jakobshavn were of opposite sign, but Dr. Loewe finds that the contrast with west Greenland is greater for the region around the Baltic than for Vienna. He gives a table of temperature anomalies for the nine warmest and nine coldest winters at each of the three stations, Jakobshavn, Breslau and Uppsala, for the period 1876-1930, and the corresponding anomalies at the other two stations, which illustrates the effect very well. The 54 sets of figures contain only two years, 1916 and 1930, with big simultaneous positive anomalies on both sides of the North Atlantic. The main reason for the see-saw is clearly to be found in pressure conditions between Greenland and Norway, high pressure tending to bring polar air down to the Baltic and tropical air up to West Greenland, and low pressure in the same area a reversed exchange of tropical and polar air.

Fluoroform

A MINUTE amount of a substance which was probably fluoroform, CHF_3 , was obtained by Meslans in 1894 by the interaction of iodoform and silver fluoride. It was prepared in a pure state by Ruff in 1936 by the interaction of iodoform with a mixture of mercurous and calcium fluorides. A. L. Henne (*J. Amer. Chem. Soc.*, **59**, 1200; 1937) has now described a method suitable for larger scale preparation. In this, bromoform is heated in a closed steel vessel with antimony fluoride (SbF_5) and some bromine. This gives the substance CHF_3Br , b.p. -14.6° . This is carefully purified and is then treated with mercuric fluoride in a similar apparatus, with special temperature control. The gaseous CHF_3 evolved is collected over water, condensed by liquid air and distilled through a condenser cooled at -80° ; CHF_3 (b.p. -88.2°) passes on. The substance is very inert chemically and physiologically. Alkalis and acids are unaffected by it, bromine does not react in

bright sunlight, but fluorine reacts vigorously with formation of CF_4 and HF . The atomic distance between the carbon and fluorine atoms (as measured by L. O. Brockway) is 1.35 Å. By the action of chlorine in bright sunlight, hydrogen is replaced and CClF_3 formed. This boils at -81.1° and, as CHF_3 , boils at -82.2° , it is seen that in these compounds a replacement of hydrogen by chlorine has caused a rise in boiling point of only 1° .

Effect of Pressure on Phosphors

It is well known that powdering a phosphor results in a diminution of the intensity of the light emitted, but that uniform pressure produces no change in the intensity. Smekal's theory gives a satisfactory explanation of the effect of powdering. A comprehensive investigation of the effect has now been made (N. Riehl and H. Ortman, *Ann. Physik.*, [v], **29**, 556; 1937). It was first shown that powdering does not affect the specific gravity of either zinc sulphide or alkaline earth sulphide phosphors. An attempt was then made to determine the percentage of active centres which are rendered inactive by the effect of pressure, the work being confined to the zinc, calcium and strontium sulphide phosphors. The opinion is expressed that the absolute effect of pressure was widely overstated in the earlier work, the reason being that the transparency of the phosphorescent layer was greatly decreased by powdering. For a medium-powdered phosphor it is estimated that the effect is only to reduce the intensity of the emission by 10 per cent, and this is near the limit of accuracy of the experiment. For an extremely finely powdered phosphor the diminution was only about 36 per cent. A rough estimation of the number of centres which come to the surface on account of the powdering agrees well with the experimentally determined decrease in intensity.

Spectrum of Nova Herculis

A LARGE number of papers on the spectrum of Nova Herculis has appeared since the discovery of this star in 1934, but one of the most complete and detailed accounts is that published recently by D. B. McLaughlin (*Pub. Obs. of Univ. of Michigan*, **6**, No. 12). The method of presenting the observational material is worthy of note, since the author discards "that most deadly of methods of discussion: the day-to-day journal of observations" and divides the history of the nova into typical stages, with separate treatment of each stage as a unit. Day-to-day changes of more important characters are, however, to be found in the numerous tables or diagrams. Wave-lengths, identifications, intensities and radial velocities are given for each group of absorption or emission lines which occurred in the various stages considered, together with critical accounts of the main features typifying each stage. It is impossible to summarize the many interesting results obtained, but special mention might be made of the anomalous behaviour of the Mg II line at 4481 Å., which showed radial velocity changes at variance with those of all the other absorption lines. It is described as "one of the most remarkable enigmas of the Nova spectrum". Some correlations are found between spectral changes and luminosity, and a tentative hypothesis is offered in which an interesting variant of the expanding shells hypothesis appears to give a satisfactory physical interpretation of the principal features observed.

The Relation of Growth Substances to Horticultural Practice*

By Dr. M. A. H. Tincker, Royal Horticultural Society, Wisley

MUCH of our recent knowledge of plant hormones we owe to the Utrecht botanists, whose investigations led to the recognition of the nature and function of these substances. Earlier experiments carried out with seedling oats showed that the shoot apex produced substances capable of regulating growth. When cut off and placed on gelatin, quantities exuded from the tips of the active substances proportional to the number of seedlings used for a fixed period of exudation. These substances could be transferred to other seedlings. A wide search was made for a ready source of these compounds, found to be present in small quantity in grain, pollen and leaves. Higher concentrations are available in urine.

At the Leicester meeting of the British Association Prof. F. Kogl described the isolation and chemical recognition of auxin *a* and *b*. Their structure is complicated; but with these two compounds a third active compound, hetero-auxin, was found. It is a simpler chemical, β -indolyl acetic acid, previously well known to chemists.

Small quantities (5 mgm.) of indolyl acetic acid when applied in lanolin, a convenient solvent, to the young stems of tomato plants growing vigorously, cause within 24 hours twisting and bending of the petioles and stems, as unequal growth takes place on the two sides. This is a quick ready means of testing closely related and other chemicals. In a few days, roots appear from the stem, root initials also develop inside, clearly seen by cutting the stem longitudinally. Similarly, the production of roots may be induced in severed portions of plants, and this is the practical point, for vegetative reproduction is thus facilitated.

The paste method has been largely superseded by dilute solutions. Herbaceous or woody cuttings are taken with expanded leaves, their basal ends placed in the solution to a depth of an inch; owing to the loss of water in transpiration from the leaves, sufficient solution is taken up to induce subsequent root production when the cuttings are placed, after washing in water, in sand in propagating frames.

The list of active chemicals includes the related indolyl butyric and indolyl propionic acids. The organic salts or esters of these acids are active, so are some of their metallic salts such as sodium indolyl-acetate. Scatole has recently been proved active. Alpha and beta naphthalene acetic acid are very highly active, phenyl acetic and anthracene acetic acid are less active.

Although fairly closely related, iso-indolinone is inactive. The substitution of sulphur for the nitrogen and hydrogen group in indolyl acetic acid very greatly reduces the activity. Although closely related to indolyl propionic acid, tryptophan is inactive; it may be a stage in the formation of the growth substance in Nature.

The treatment causes: (a) more cuttings to form roots; (b) more roots to be formed on each cutting;

(c) the active process (including *a* and *b*) to be accelerated.

Amongst herbaceous plants, cuttings of lupins, delphiniums, pelargoniums, violas and alpine phlox have shown accelerated rooting by treatment with pastes in lanolin and with very weak solutions. There is a tendency to damage delicate tissue by the use of solutions of too high a concentration; 1 part in 30,000 or 40,000 parts of water is recommended for such cuttings.

With holly, taken at the end of June and treated with indolyl acetic acid, 1 part in 10,000 of water for 24 hours, half the cuttings rooted in 6 weeks whilst none of the controls, placed in water for 24 hours, rooted in this time. With *Viburnum Carlesii*, cuttings taken at the end of July and treated with alpha naphthalene acetic and others with indolyl acetic, 1 part in 10,000 of water for 24 hours, rooting took place rapidly. In ten days, the active growth taking place inside the stem split the outer layers. Cuttings of *Ceanothus dentatus* taken in late November produced roots in January, and *Myrtus communis* cuttings taken in January rooted in a month. Stimulation may occur at a season of normal quiescence.

Species and varieties of heather (*Erica*) responded quickly to alpha naphthalene acetic acid, *Pieris formosa* taken in late August and *Gaultheria procumbens* have given favourable results. With *Rhododendron rubiginosum*, 85 per cent of the cuttings treated in alpha naphthalene acetic acid and indolyl acetic acid, 1 in 20,000 for 48 hours, rooted in three months, whilst only 5 per cent of the controls form roots. Other plants tested include species of *Buddleia*, *Camellia*, *Deutzia*, *Escallonia*, *Hydrangea*, *Pernettya*, all of which showed favourable results by these methods. Even with the more recalcitrant genera and species some encouraging results have already been obtained. Further results are reported in tests made by horticultural and chemical firms, and at other research stations and laboratories. These greatly extend the list of species in which root formation has been accelerated. Certain species may yet prove quite unresponsive but the indications are to the contrary, provided the time of year and concentration of solution can be correctly selected.

The concentrations are surprisingly low, for frequently 1 in 40,000 of water is effective. It appears from certain *ad hoc* tests that there is a critical concentration below which little or no activity is induced. Twice the length of time for uptake from a solution half as concentrated may not be so effective as a stronger solution used for the given time.

Pouring solution on to the sand before inserting cuttings is not recommended, as bacteria interfere. Freshly made solutions should be used as moulds and bacteria may contaminate them if kept. Since the solutions are not stable in light, storage in coloured and opaque vessels at higher concentration is recommended.

The success obtained has been quickly appreciated

* Substance of a lecture to Section K (Botany) of the British Association, delivered at Nottingham on September 3.

by chemical manufacturers and by horticulturalists. There are now a number of solutions readily available on the market in many countries.

Thus it is seen that investigations, primarily of botanical interest, dealing with fundamental problems

of plant development, have quickly led to results of much interest and value to the practical man; showing once more the relationship of science and its discoveries to everyday life, to industry and to recreational pursuits.

The Teaching of Geology in Schools

JUST over two years ago, at the Norwich meeting of the British Association, Section C (Geology) appointed a committee to report on questions affecting the teaching of geology in schools. A short report was presented at the 1936 meeting of the Association, and, at the suggestion of members of Section L (Education), an extended report giving detailed proposals was prepared for the Nottingham meeting. These reports were discussed in a joint meeting of Sections C and L, at which Mr. H. G. Wells presided, on September 7.

The views of the geologists were explained by Prof. A. E. Trueman, who opened the discussion, Prof. G. Hickling, Prof. W. W. Watts, Prof. L. J. Wills, Sir Lewis Fernald and Prof. P. G. H. Boswell. It was pointed out that, while geology has never figured very prominently in school curricula, many pupils were formerly introduced to it, for example, on field excursions, by teachers who had received some training in the subject, but that few intending teachers at present are encouraged to include it in their university or college courses. While appreciating something of the difficulties of the overcrowded curriculum, it was felt that geology should be more widely included in school courses. The Committee did not press its claims in competition with any other subject; in general, while it wished to secure the inclusion of some outlines of geological knowledge in all science courses in secondary schools (for example, as a part of schemes of 'general science'), it only asked, in addition, that geology should be included as an optional subject at more advanced stages. The inclusion of some geology in the scheme of informative education outlined by Mr. Wells in his address to the Education Section was noted with keen satisfaction.

Both the cultural and utilitarian aspects of geology were emphasized. It is one of the richest of cultures, stimulating a broader interest in the outside world and increasing the appreciation of scenery. On the other hand, it is an eminently useful science with numerous and obvious applications in mining, engineering and agriculture. It was suggested that geology should form an essential part of the school curriculum in mining and industrial areas, partly on account of its economic importance, partly for the wider interest it would give to later life.

The syllabuses proposed by the Committee are intended only as suggestions, and great elasticity of treatment appears to be desirable in the case of geology even more than in other sciences, the bias and the arrangement of the various topics depending largely on the location of the school.

In the senior elementary schools there is more opportunity for variety of treatment, and a rather practical bias is suggested. Dr. W. K. Spencer described some of the work carried out in such schools.

The lack of any courses in geology in most schools was held responsible for the present dearth of trained

geologists; Prof. Hickling and Prof. Watts pointed out that while the supply is thus restricted the demand for geologists is increasing. It was emphasized that there are attractive careers in this field for a number of men of ability and good physique.

Two teachers who took part in the discussion expressed rather different points of view. First, Mr. James Davies, one of the few teachers who are actually teaching geology in secondary schools, indicated the nature of his courses. In pleading for a wider adoption of geology he spoke of the attractiveness of the subject and said that there is nothing more inspiring than leading a party of young people over hill and dale (his school is in South Wales). As an example of the chance of a beginner in geology making new discoveries, he mentioned the first recognition of a marine band in the Coal Measures by one of his pupils. In his school, both geology and geography appear in the curriculum. On the other hand, Mr. V. C. Spary, speaking as a teacher of geography, expressed fears that the introduction of geology into the time-table could only mean the displacement of geography. He agreed, however, that a well-balanced course of geography must include many lessons of a geological nature, for "geography teachers must borrow a great deal", and he thought it a great advantage for teachers of that subject to have some geological training.

Mr. Wells agreed with Mr. Spary that the teaching of geology as a specific subject is not highly desirable until an advanced stage in education is reached, but thought that reference would nevertheless be made at earlier stages to the geological record when teaching biology, and to physiography in teaching geography. He went on to inquire what constitutes geological training when the biological and physiographical sides are taken away. In reply to these questions it was insisted that palaeontology and physiography are branches of geology, and while it may be convenient to treat them in relation to other subjects in the curriculum, it is desirable that the pupils should know that they are then learning geology. Anxious as they are to see their subject taught in schools, geologists would much prefer to have it taught under its own name.

In the course of the discussion, there was no real criticism of the view that geology should be taught in schools; there was, however, this difference of opinion as to whether it should appear as a separate subject except at more advanced stages (for example, at the Higher School Certificate stage). The inclusion of the subject as a part of a course in 'general science' would possibly be the most satisfactory solution in many schools, up to the stage of the School Certificate, as the Committee had recommended.

In connexion with the discussion, Prof. H. H. Swinnerton arranged an interesting exhibit to show a course of simple experimental work in geology suitable for schools.

Fossil Man in Minnesota*

IT is probable that there is no skeleton of ancient man of which the circumstances and conditions of discovery have been more carefully documented than that of the skeleton found in the ancient glacial lake deposits, now known as "Lake Pelican", beneath Minnesota Highway No. 30, near Pelican Rapids, on June 18, 1931 (see NATURE, Feb. 27, p. 365). Prof. A. E. Jenks, in his detailed account of the skeleton, has been careful to secure statements from all who were concerned in the discovery of this skeleton; and the facts were further checked by a re-excavation on the site, in which the circumstances received further confirmation by the occurrence of more fragments of the skeleton.

The skeleton was unearthed at a depth of some twelve feet in the course of repairs to a recently made road, when a mechanical excavator was noticed by the workmen to have crushed a clam shell. A closer examination revealed the existence of a skeleton, which on removal proved to be virtually complete. One tooth, lost after discovery, is missing, as are the nasal and some of the smaller bones, such as those of one hand and the feet.

Minnesota is the centre of an area of some thousand miles in extent which, as a zone of terminal moraines and a 'driftless area,' would have been peculiarly favourable for the existence of glacial man. The ancient glacial lake system to which belong the deposits in which the skeletal remains were found is of late Pleistocene date. This area would have been readily accessible to early man entering America by either the Arctic coast or the Yukon valley, and thence coming south-eastward along the Mackenzie River and on the east of the Rocky Mountains, and thereafter in a generally eastward direction along the Missouri River. Hence access could readily be gained to the various centres in America in which forms of aboriginal culture developed later.

The skeleton as a whole, as already mentioned, is very complete. It is that of a sub-adult female of about fifteen years. The bones are mineralized, and little affected by the silt in which they lay. There can be no question of a modern burial, and the supposition is that the young woman was drowned in glacial Lake Pelican about half a mile from the foot of the glacier, possibly having fallen through the ice.

The characteristics of the cranium are not distinctively primitive in type, except in the backward extension of the skull and the 'houseboat' shape, which is also characteristic of the Australian and Eskimo. The cephalic index, 77.09, distinctly mesocephalic, and therefore higher than in the Mousterian and Aurignacian types, and the head-height indices are not very distinctive of race, falling in the median categories, which may be found in all the great groupings of mankind. The cranial vault shows a number of primitive characters, of which the more noteworthy are the prominent glabella, the absolutely and relatively long temporal margin of the parietal bone, the low index of the squamous portion of the temporal bone, the high position of theinion above

the Frankfort plane, and the flatness of the nuchal area. A number of unique or unusual features are shown, such as the U-shaped grooves of the occiput and the columnar form of the bases of the pterygoid processes.

The face as a whole shows an important primitive characteristic in the marked alveolar prognathism combined with mid-facial orthognathism. In this it most closely resembles neanthropic palaeolithic Europeans. In other measurements and indices the resemblance is nearest to the Mongoloid and White groups. As contrasting with certain Amerindian groups, it is both higher and narrower; yet it is within the group means of Algonkins, and in breadth within the range of the Siouan group. In orbital index the specimen falls with the Mongoloids; while the interorbital breadth and index are Mongoloid. The nasal index is closest to the White, yet certain of the Mongoloid groups have similar indices. The forward thrust of the malars is Mongoloid; while the mandibular index is closer to that of the Australians than of any other living race.

The teeth exhibit important primitive characters. They are absolutely large in every respect. In the relative length of the lower molars the third is the greatest, which gives them a unique formula. The cusps of none of the molars show any reduction in number, and they retain the primitive crown patterns. The shovel-shaped upper incisors, though characteristic of the modern Mongoloids, seem to be a primitive character.

The stature as computed from the long bones is 1,582 mm. (Manouvrier) or 1,540 mm. (Pearson). This, on Manouvrier's method, is slightly above the average for females generally, which is 1,530-1,539 (Martin). The figure is above the Mongoloid average, which is generally lower than European and Negro.

Artefacts were found with the remains. The clam shell crushed by the grader has been identified as *Lampsilis siliquoidea*. As this lay above the frontal bone it may have been part of the headdress. An antler dagger, broken at the time of discovery, lay to the right of the right humerus, and has been identified as part of the tine on the main beam of an elk antler. It is 196 mm. in length and had been fashioned by a coarse cutting implement. Its butt end is perforated. A conch shell pendant was found among the ribs and vertebrae in the abdominal area. At the second re-digging of the site sixty fragments of turtle carapace were recovered, also fragments of antler, metatarsal of a loon, toe bones of a bird's foot, a wolf's tooth, and the calcaneum of a rodent. The whole possibly was a 'medicine' outfit.

The general deductions are that the skeleton named 'Minnesota man' has been found geologically documented in undisturbed sediment of late Pleistocene origin in the area immediately east of the Big Stone Moraine of the Wisconsin glacier; and that the measured and observed morphological characters of this skeleton proclaim it to be a primitive *Homo sapiens* of an early type of evolving Mongoloid, already prophetically suggesting American aborigines, especially the Eskimo, more than the present Asian Mongoloids, and living in west central Minnesota about twenty thousand years ago in late Pleistocene times.

* Pleistocene Man in Minnesota: a Fossil *Homo Sapiens*. By Dr. Albert Ernest Jenks. With a Chapter on the Pleistocene Geology of the Prairie Lake Region, by Dr. George A. Thiel. Pp. xiv+197. (Minneapolis, Minn.: University of Minnesota Press; London: Oxford University Press, 1936.) 34s. net.

Naval Architecture and Engineering

A SAILING yacht, being designed to attain the highest speed without the usual restrictive commercial considerations, provides an opportunity for the development of the ideal form of hull. If this is nicely balanced, the yacht keeps her course when heeled over, whereas if, on heeling, she tends to change course, she becomes a difficult boat to steer and can be described as unbalanced. In "A Law of Hydrostatics and its Influence on the Shapes of Sailing Yachts"—a paper read at the spring meeting of the Institution of Naval Architects held in March—Engineer Rear-Admiral Alfred Turner dealt with this question of balance. On heeling, the hull displaces an unsymmetrical volume of water, and may be considered as resting on the line of centres of buoyancy described as the metacentric shelf. This line does not form a plane curve; it may be very irregular, and from its irregularities there may arise a variable tendency to alter course according to angle of heel. The author investigates this by poising transparent paper patterns of a set of cross-sections and, after setting out Bouguer's law of balance with slight modifications, explains, by reference to the characteristics of some thirty-six vessels of which diagrams are given, the rules he has formulated.

In another paper, "The Development of the Two-stroke Cycle Oil Engine", read at this session, Mr. W. S. Burn, treating the subject from the marine point of view, explained its advantages over the four-stroke type in offering a cheaper, smaller, lighter and more efficient unit. The feature of first importance in its design is the evolution of a satisfactory method of scavenging, a process which has to be completed during the small movement of the piston and the small interval of time in which the exhaust ports are open. By means of a set of diagrams illustrating successful systems in use, the author explained their merits and classified them as uniflow or double-flow types. Scavenging being satisfactorily provided for, the two-stroke engine is shown to present, in other respects, a simpler problem for the designer owing to the greater freedom in arranging the combustion chamber, the cylinder head and piston crown, on each of which useful comment was made.

Marine steam boilers have, in the past, been regarded as immune from what is known as 'caustic embrittlement', but as in recent years a few cases have occurred in which the shells were found to be seriously affected and were condemned as unfit for further service, the problem has demanded the attention of marine engineers. The term is more picturesque than accurate, but the nature of the attack is characteristic and well defined, taking the form of intercrystalline fracture due to chemical action occurring only at the seams where two surfaces are in contact, and when the water is strongly alkaline and low in sulphates. The cracks follow the grain boundaries and are not transcrystalline as in the case of fatigue fractures. These points were illustrated by photomicrographs in a paper entitled "Note on the Chemical Intercrystalline Fracture of Riveted Joints in Boilers" read by Dr. S. F. Dorey, in which also he showed how the cracks in several joints examined were found to extend along the lines of rivet holes and along radial lines from these holes, invariably on the faces in contact.

While these results have always occurred in cases in which caustic soda was present, recent investigations suggest that the actual cause is the presence of sodium silicate in the soda or other chemicals used in the boilers. As soda was used in boilers long before caustic embrittlement was spoken of, the author thinks that possibly some difference in the method of manufacture of soda during the last thirty years may account for it and suggests that particulars of the analysis of the earlier supplies of soda may give some hint. He advises that care should be taken that nothing containing sodium silicate should be used in the treatment of boiler water and that, where soda is necessary, no more should be used than will maintain a neutral condition.

Science News a Century Ago

The Morse Recording Electric Telegraph

On October 3, 1837, Samuel Finley Breese Morse, the American artist and professor of the "Arts of Design" at the New York City University, filed in the United States Patent Office a "Caveat" comprising: "1st, a system of signs by which numbers and consequently words and sentences are signified; 2nd, a set of type adapted to regulate and communicate the signs, with cases for convenient keeping of the type, and rules in which to set up the type; 3rd, an apparatus called a port-rule for regulating the movement of the type-rules, which rules by means of the type in their turn regulate the times and intervals of the passage of electricity; 4th, a register which records the signs permanently; 5th, a dictionary or vocabulary of words numbered and adapted to this system of telegraph; 6th, modes of laying the conductors to preserve them from injury."

Morse was born in 1791. He was the oldest son of Jedidiah Morse (1761-1826), "the first American geographer". Educated at Yale College, he determined to be a painter, and at the Royal Academy in London in 1813 exhibited his picture "The Dying Hercules". During 1829-32 he paid his second visit to Europe, studying art in France and Italy, and it was on his passage home in the sailing ship *Sully* that, after a conversation on the possibility of sending electric currents along wires, he conceived the "Morse code". He had little scientific knowledge, but at the New York City University was assisted by Leonard W. Gale, professor of chemistry, who was acquainted with the work of Henry.

On September 4, 1837, with an apparatus made by Morse, a continuous dispatch was effected in the form of V-shaped lines inscribed on a paper fillet, consisting of the numbers "215-36-2-58-112-04-01837" which, interpreted by a numbered vocabulary, made the phrase "successful experiment with electric telegraph, September 4, 1837". Early in 1838, Morse discarded the numerals and employed an alphabet of 'dots and dashes'.

The Thermo-electric Light

In the *London and Edinburgh Philosophical Magazine* of October 1837 is a communication from Francis Watkins, a partner in the firm of Watkins and Hill, opticians and philosophical instrument makers, of 5 Charing Cross, in which he says: "I

hope you will allow me to make known in your forthcoming publication a fact in thermo-electricity which I have observed since my last communication to you, and which I believe has not been noticed in print in this or any other country.

"With a pair of metallic elements, consisting of one bismuth and one antimony, weighing each five grains and measuring 0.5 of an inch long and 0.12 diameter, when their extremities were unevenly heated, I have obtained with a Henry's flat ribbon coil, a very perceptible and brilliant spark.

"I have had the pleasure of showing the experiment to MM. De la Rive, Plateau and Netschayef, and I need not add that these distinguished philosophers were much delighted on seeing the thermo-electric light developed by a single pair of metallic elements."

Medical Mission to China

THE following announcement is contained in the *British and Foreign Medical Review* of October, 1937: "The London Missionary Society is desirous of finding medical men adapted to execute its benevolent designs for the improvement of the vast and interesting population of China. To candidates properly qualified such an undertaking must be highly attractive. In a scientific point of view China presents a field of observation of great variety and extent. With slight exceptions the state of medical knowledge is extremely low and defective, and notwithstanding their inordinate national vanity, many of the inhabitants are beginning to recognize the superiority of Europeans in this as in many other departments. A competent endowment of medical science and more especially a talent for operative and ophthalmic surgery, would be a sure passport of popularity and reputation under such circumstances; and we can hardly imagine a situation more calculated to excite and gratify the honourable ambition and philanthropic feelings of generous and adventurous work."

The Medical Literature of Norway

THE following extract is taken from a paper in the *British and Foreign Medical Review* of October, 1937, by Prof. Frederick Holst, professor of medicine at the Royal Frederick's University at Christiania: "The medical literature of Norway is but of small extent, and will probably always continue such in proportion to the population; as the latter is not great, the medical practitioners are but few, and the language of the country is understood by very few out of Scandinavia. Consequently, neither the medical man who might feel inclined to come forward as an author, nor the bookseller who is able to undertake the cost of printing the work, has the same encouragement as in other countries. It would therefore be unjust to consider the paucity of literary productions in that country as a proof of the incompetence of its medical men. The facilities of communication with other countries makes them pretty soon acquainted with foreign publications on subjects in their department; and in Norway there is no well-informed practitioner who does not take one or more of the best foreign medical journals, and procure the more important works by foreign medical writers. The medical works that have appeared in Norway have, in almost every instance, been called forth by particular occasions, or possess merely a private or local interest."

Societies and Academies

Paris

Academy of Sciences, July 26 (*C.R.*, 205, 265-300).

NIKOLA OBRECHKOFF: The solutions of a system of linear finite difference equations of the first order with constant coefficients.

JEAN LERAY: Discussion of the problem of Dirichlet.

FOLKE ODQVIST: Complete equations of equilibrium of thin elastic skew layers.

GEORGES CARPÈNI: The dissociation constants of d-glucoscorbic acid and of its product of oxidation by iodine. The absorption ultra-violet spectra of d-glucoscorbic acid.

HENRI MOUREU, MICHEL MAGAT and GEORGES WÉTROFF: The Raman spectra of the two forms of phosphorus pentachloride. From the study of the Raman spectra of phosphorus pentachloride in the solid and liquid states, it is found that this substance has two distinct molecular forms, changing from one to the other on fusion. The partially fused substance shows the two spectra superposed. In liquid form the molecule possesses the symmetry of a trigonal bipyramid; the Raman spectrum of the solid form can be interpreted in more than one way. The Langmuir formula $(PCl_4) + Cl^-$ is consistent with the results.

MOISE NEUMANN and PAUL TOUTAKIN: The dissociation of peroxides and the cold flame of hydrocarbons. Experiments confirming the theory of Alvazov and Neumann on the formation of cold flames during the oxidation of hydrocarbons, the intermediate oxidation product being a peroxide.

MILLE, ALICE LACOURT: The volumetric micro-estimation of oxygen (ter Meulen method).

FÉLIX FRANÇOIS and Mlle. MARIE LOUISE DELWAULLE: The isothermal decomposition of the nickel peroxides.

DINAH ABRACAM and YVES DEUX: The fixation of hypochlorous acid on phenylbutadiene and the isomerization of the corresponding epoxide into phenylcrotonaldehyde.

MIGUEL POCTIVAS and Mlle. BIANCA TCHOUBAR: The action of C_6H_5MgBr and of $MgBr_2$ on the oxide of dimethylstyrolene.

EDOUARD ROCH: The Oligo-Miocene of the southern slope of the Moroccan Haut-Atlas.

RENÉ ABRAR and EDGAR AUBERT DE LA RÛE: The presence of the Pliocene at the island of Malekula (New Hebrides).

DANIEL AUGER: Complex pulsations of the action current produced in *Nitella* by the action of certain buffer substances.

ROBERT ECHEVIN and ARTHUR BRUNEL: Ureides and free urea, the degradation of the purins in *Soja hispida*.

YVES LE GRAND and EUGÈNE GEBLEWICZ: Fluttering in lateral vision.

ERNEST FOURNEAU, M. and MME. JACQUES TRÉFOUËL, FEDERICO NITTI and DANIEL BOVET: The chemiotherapy of pneumococcal infection by di(p-acetylaminophenyl) sulphone (1390F).

Calcutta

National Institute of Sciences of India, August 27-28.

R. N. CHOPRA: Therapeutics of antimalarial drugs.

A. C. BANERJEE: Urban malaria in the United Provinces.

R. B. LAL: Methods of forecasting malarial epidemics.

- FROILANO DE MELLO: Malaria in Portuguese India.
 R. SENIOR WHITE: Physical factors in mosquito ecology.
 W. C. SWEET: Irrigation and malaria.
 T. A. CURRY: Flood and flush schemes in Bengal.
 F. C. GRIFFEN: Surface and subsoil drainage.
 S. G. MASILLAMANI: Irrigation and malaria in the Madras Presidency.
 M. O. T. IYENGAR: Topography of land in relation to malaria.
 P. SEN: *Anopheles ludlowii* survey in and around Calcutta.
 G. C. CHATTERJEE: Malaria and its relation to agriculture in India.
 M. K. AFRIDI: Antimalarial operations in Delhi.
 B. A. RAO: Control of anopheline breeding in irrigation channels by Paris green.
 J. D. SINHA: Drug prophylaxis in malaria by the use of quinine and plasmoquine in the field.
 K. V. KRISHNAN: The spleen and resistance to malaria and hæmoglobinuria.
 K. L. CHOWDHURY: Mosquito control in Calcutta.
 G. C. CHATTERJEE: Larvivorous fish.
 S. L. HORA: Larvicidal fish.
 R. N. CHOPRA: Experimental studies on ape malaria with reference to its use in therapy for nervous conditions.
 B. B. DIKSHIT: Pharmacology of plasmochin with special reference to its action in pregnancy.
 K. V. KRISHNAN: Biochemical changes in the blood of monkeys developing malarial hæmoglobinuria and their significance in the etiology and treatment of blackwater fever in man.
 B. M. DAS GUPTA: Transmission of *P. inui* to man.
 M. O. T. IYENGAR: Natural parasites of mosquitoes in India.
 S. L. HORA and K. K. NAIR: Observations on the nutrition of *Panchax panchax*.
 A. G. FRASER: Observations on the bionomics of *Panchax panchax*.
 H. N. RAY: The development of bird malaria parasites in endothelial cells.
 D. N. ROY: Salt water *rossi* as a malaria carrier.
 M. N. DE: The pathology of malarial spleen.

Moscow

Academy of Sciences (C.R., 15, No. 6-7; 1937).

- I. M. VINOGRADOV: Representation of an odd number as a sum of three primes.
 D. MENŠOV: The series of orthogonal functions limited in their totality.
 A. A. IVANOV: The most probable orbit of the small planet (122) Gerda, from observations at thirty-four oppositions from 1872 to 1934.
 M. KURENSKIY: Fundamental formulæ for the calculation of elements of a trajectory of the centre of gravity of a projectile.
 V. FURDUSEV: A method of acoustical design of rooms equipped with loud speakers.
 S. LIFSHTITZ: Experimental investigations of reverberation optimum for different frequencies.
 W. W. SHOULEJKIN: The principles of the monsoon theory.
 L. A. TUMERMANN and V. ŠYMANOVSKIY: A fluorometer based on the effect of Debye and Sears.
 K. S. LJALIKOV: Experimental verification of the Thomson formula.
 N. S. KURNAKOV, G. B. BOKIJ and I. N. LEPEŠKOV: Kainite and polyhalite in salt deposits of the Soviet Union.

V. I. NIKOLAJEV, O. K. JANATJEVA and V. D. POLJAKOV: The potassium deposits on the right side of the Volga and in Kalmykia.

I. I. ČERNIAJEV and V. I. GOREMYKIN: (1) Hydroxylamine-pyridine compounds of bivalent platinum. (2) Oxidation of hydroxylamine compounds of platinum.

F. M. ŠEMIARIN: The reactions of rare earths and allied elements with pyrogallol, gallic acid and morphine (5).

A. I. ZUJTIN: Influence of temperature contrasts on the frequency of lethal mutations in *Drosophila melanogaster*.

A. M. GROSSMAN: The elimination of supernumerary chromosomes in *Zea mays*.

I. SOKOLOV: The chromosomes in the spermatogenesis of the domestic ass.

V. I. TOVARNITSKIY and T. L. RIVKIND: Hormonization of seeds. Treatment of seeds with a solution of equine urine, known to contain substances of hormone nature, resulted in an increase in the yield of grain up to 60 per cent.

B. S. ZAKHAROV: The problem of vernalization of *Perilla*.

T. T. DEMIDENKO and N. P. MARTYNOV: The effect of the osmotic pressure of soil solution on the yield and composition of sugar-beet.

T. T. DEMIDENKO and V. P. GOLLE: The influence of light on the inflow of nutrient substances in plants.

N. V. NASSONOV: The effect of the subcutaneous insertion of epithelial, osseous and muscular tissues on the surrounding tissues in axolotls.

L. V. POLEŽAEV: The determination of a regenerating extremity in axolotl.

A. M. VASJUTOČKIN: Some derivatives of the epithelial framework of the thymus gland of an amphibian.

A. A. VOITKEVIČ: Morphogenetic activity of different parts of the hypophysis. (3) The influence of different zones of the anterior lobes of hypophysis on the thyroid gland of Amphibia. (4) Inhibition of metamorphosis of tadpoles by the substance of the "eosinophilous zone" of the anterior lobes of the hypophysis.

S. M. ANDRONOV: *Gigantella* Sars and its stratigraphic importance in the Lower Carboniferous deposits of the middle course of the Ishim River.

Rome

National Academy of the Lincei (*Atti*, 25, 149-196; 1793).

E. BOMPIANI: Construction of surface elements starting from curvilinear elements.

G. GIORGI: A method for calculating distortion effects in telegraph and telephone wires.

W. BLASCHKE: Invariants of complexes.

E. BORTOLOTTI: Moutard's quadratics and the canonic bundle.

R. CALAPSO: Some surfaces of the third and fourth order.

W. DOEBLIN: Continuous case of chain probabilities.

G. ARRIGHI: Observations on the Newtonian motion of any two masses.

L. MARTINELLI: Luminosity of the images which appear in a telescope.

G. OCCHIALINI: Gamma radiations of polonium-beryllium.

A. BARONI: Non-existence of bismuthous bromide, BiBr₃.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT WATER ENGINEER in the County Borough of Croydon—Town Clerk, application forms from Borough Engineer (October 5).

JUNIOR ASSISTANT in the Development Department, British Non-Ferrous Metals Research Association, Regnart Buildings, Euston Street, N.W.1—Secretary (October 8).

LECTURER IN BACTERIOLOGY in the FACULTY OF MEDICINE, University of Birmingham—Secretary (October 9).

LECTURER IN CIVIL ENGINEERING at University College, Nottingham—Registrar (October 15).

SECOND ASSISTANT ENGINEER to the Rivers Mersey and Irwell Catchment Board—Engineer to the Board, Carrington Lane, Sale, Cheshire (October 16).

ASSISTANT (biology) in the Museum and Art Galleries, Paisley—The Clerks to the Committee, Young, Martin and Sauers, 4 St. Mirren Street, Paisley (October 20).

ASSISTANT DIRECTOR OF FISHERIES in the Straits Settlements—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, S.W.1 (October 31).

SIR HENRY ROYCE RESEARCH FELLOWSHIP for work on the common cold or on influenza—Registrar, The University, Manchester, 13 (October 31).

PROFESSOR OF SOCIAL SCIENCE in the University of Liverpool—The Registrar (November 15).

JUNIOR LECTURER and a LECTURER in ZOOLOGY in the University of Cape Town—Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (November 15).

TWO RESEARCH FELLOWSHIPS relative to the causation and pathology of rheumatic disease—Secretary, Empire Rheumatism Council, 1 Mitre Court Buildings, Temple, E.C.4 (November 15).

TWO SENIOR ELECTRICAL ENGINEERS (temporary) at the Headquarters of the Air Ministry, Admiralty House, Kingsway, W.C.2—Secretary (W.9).

ELECTRICAL ENGINEERS (temporary) in the Directorate of Works, Air Ministry, Admiralty House, Kingsway, W.C.2—Secretary (W.9).

ASSISTANT MECHANICAL ENGINEER in the Locomotive, Carriage and Wagon Workshops of the South Indian Railway Co., Ltd.—Messrs. Robert White and Partners, 3 Victoria Street, S.W.1.

Official Publications Received

Great Britain and Ireland

Saoirstat Eireann: Roinn Talmhaíochta (Department of Agriculture): *Brainte Iascaigh* (Fisheries Branch). Statistics of Salmon, Sea Trout and Eels captured during the Years 1935, 1936, 1937, 1938 and 1939. (P. No. 2027.) Pp. 16. (Dublin: Stationery Office.) 3d. [109]

Britain's New Forests. Pp. 12. (London: Forestry Commission.) [109]

Chelsea Polytechnic. Prospectus, Session 1937-38. Pp. 61. Chelsea School of Art: Prospectus, Session 1937-38. Pp. 16. Chelsea College of Physical Education: Session 1937-38. Pp. 14. Chelsea School of Pharmacy: Prospectus, Session 1937-38. Pp. 19. Chelsea School of Cookery, Housecraft, Dressmaking and Millinery: Prospectus, Session 1937-38. Pp. 10. Chelsea School of Chiropody: Prospectus, Session 1937-38. Pp. 14. Chelsea School of Metallurgy: Prospectus, Session 1937-38. Pp. 18. (London: Chelsea Polytechnic.) [109]

British Film Institute. Science Teaching Films: a Report presented to the Governing Body of the British Film Institute by the Science Committee of the Education Panel. Pp. 44. (London: British Film Institute.) 6d. [159]

Queen Mary College (University of London). Calendar, Session 1937-1938. Pp. 238. (London: Queen Mary College.) [159]

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Humphrey Lluyd's Maps of England and of Wales. By Dr. F. J. North. Pp. 59+5 plates. (Cardiff: National Museum of Wales.) 1s. [159]

Medical Research Council. Seventeenth Annual Report of the Industrial Health Research Board to 30th June 1937. Pp. iii+30. (London: H.M. Stationery Office.) 9d. net. [159]

Bacon Development Board. Bulletin No. 2: Substitutes for Cereals in Pig Keeping. Pp. 62. (London: Bacon Development Board.) 2s. [159]

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 1, No. 6: Metamorphic Correlation in the Polymetamorphic Rocks of the Vaila Field Block, Unst, Shetland Islands. By Dr. H. H. Read. Pp. 195-221+2 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 4s. [159]

Vitamin D in Cacao Shell (Commercial Cocoa Bean Shell): Reports on Recent Researches, including Investigations into its Use as an Accessory Fodder. Reprinted from various publications and edited by A. W. Knapp. (Technical Series, No. 23.) Pp. 64. (Bournville: Publication Department.) 1s. [179]

Technical Publications of the International Tin Research and Development Council. Series B, No. 5: Fusible Alloys containing Tin. By E. J. Daniels. Pp. 24. (London: International Tin Research and Development Council.) Free. [179]

Royal Technical College, Glasgow. Calendar for the One Hundred and Forty-second Session, 1937-1938. Pp. 522. (Glasgow: Royal Technical College.) [189]

Other Countries

Instituto Nacional de Tecnologia. Estudos sobre conforto termico no Brasil: O termometro resultante de Misenard. Polo Paulo 84. Pp. 24. Estudos sobre o conforto termico e o conforto visual no Brasil. Polo Paulo 84. Pp. 43. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [89]

British East African Meteorological Service. Annual Report for the Year 1936. Pp. 8+4+2+2. (Nairobi: B.E.A. Meteorological Service.) [89]

Expédition Antarctique Belge. Résultats du voyage de la Belgique en 1897-99. Rapports scientifiques. Zoology—Crinoidea. By D. Dilwyn John. Pp. 11. (Anvers: J.-E. Buschmann.) [109]

Ceylon. Part 4: Education, Science and Art (F). Administration Report of the Director of the Colombo Museum for 1936. By A. H. Malpas. Pp. F10. 20 cents. Part 4: Education, Science and Art (G). Administration Report of the Marine Biologist for the Year 1936. By A. H. Malpas. Pp. G12. 15 cents. (Colombo: Government Record Office.) [109]

Scientific Publications of the Cleveland Museum of Natural History. Vol. 7: The Birds and Mammals of the Western Slope of the Azuero Peninsula (Republic of Panama). By John Warren Aldrich and Benjamin Patterson Bole, Jr. Pp. 196. (Cleveland, Ohio: Cleveland Museum of Natural History.) [159]

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 5: Insurance and Annuity Plans for College Staffs. By Sherman E. Flanagan. Pp. v+88. (Washington, D.C.: Government Printing Office.) 10 cents. [159]

Cornell University: Agricultural Experiment Station. Bulletin 665: A Study of Price Differences in Retail Grocery Stores in New York State. By Lella Doman. Pp. 52. Bulletin 666: Body of Cultured Cream. By E. S. Guthrie. Pp. 12. Bulletin 667: Soils in relation to Fruit Growing in New York. Part 10: Susceptibility of various New York Orchard Soils in reduction upon water-logging. By Michael Peech and Damon Boynton. Pp. 20. Bulletin 668: An Economic Study of Land Utilization in Genesee County, New York. By J. N. Efferson. Pp. 42. Bulletin 669: Marketing Apples in the Champlain Valley. By G. P. Scoville. Pp. 41. Bulletin 670: An Economic Study of Grape Farms in Schuyler and Yates Counties, Crop Year 1935. By E. G. Misner. Pp. 27. Bulletin 671: Economic Studies of Vegetable Farming in New York. 1: Market-Garden Farms with Greenhouses, Rochester Area. By G. A. M. Baptist and E. G. Misner. Pp. 51. Bulletin 672: Soils in relation to Fruit Growing in New York. Part 11: The Organic-matter Content of New York Orchard Soils in relation to Orchard Performance. By Ralph W. Cummings. Pp. 26. (Ithaca, N.Y.: Cornell University.) [159]

University of California Publications in American Archaeology and Ethnology. Vol. 37, No. 4: Culture Element Distributions. 4: Pomo. By E. W. Gifford and A. L. Kröber. Pp. 117-254. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1.50 dollars. [159]

Department of Agriculture: New South Wales. Science Bulletin No. 56: Plant Breeding in New South Wales—Tenth Year of Progress, 1935-36. Pp. 50. (Sydney: Government Printer.) [159]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 107: A Soil Survey of the Coomera, Wentworth (Curlwaa), and Pomona Irrigation Settlements, N.S.W. By T. J. Marshall and Dr. Allan Walkley. Pp. 48+5 plates. Pamphlet No. 70: Further Observations on Soil Erosion and Sand Drift, with Special Reference to South-Western Queensland. By F. N. Ratcliffe. Pp. 28+6 plates. (Melbourne: Government Printer.) [159]

The Carlsberg Foundation's Oceanographical Expedition round the World, 1928-30, and previous Dana-Expeditions. Dana-Report No. 9: Contributions to the Life Histories of the Deep Sea Eels, *Synphobranchidae*, by Anton Fr. Bruun; Dana-Report No. 10: Les poissons abyssaux du genre *Cyema* Günther (Anatomie, embryologie, biologie), par Dr. Léon Bertin; Dana-Report No. 11: Les octopodes de la croisière du Dana, 1921-22, par Prof. Louis Joublin. (Published by the Carlsberg Foundation.) Pp. 32+30+50. (Copenhagen: C. A. Reitzels Forlag; London: Oxford University Press.) 12.50 kr.; 11s. [159]

The Rockefeller Foundation. Annual Report, 1936. Pp. iv+461. (New York: The Rockefeller Foundation.) [159]

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural and Chemical Series, No. 52: Scientific Irrigation Management; a Review of Investigations on Plant and Water Relations, the Waialua Irrigation Investigations, the Administration of Plantation Irrigation Water. By H. E. Shaw and J. A. Sweeney. Pp. 199-279. (Honolulu: Hawaiian Sugar Planters' Association.) [159]

U.S. Department of Agriculture. Farmer's Bulletin No. 1777: Diseases of Fur Animals. By J. E. Shillinger. Pp. ii+22. 5 cents. Miscellaneous Publication No. 258: Annotated List of the Insects and Mites associated with Stored Grain and Cereal Products, and of their Arthropod Parasites and Predators. By K. T. Cotton and N. E. Good. Pp. 81. 10 cents. (Washington, D.C.: Government Printing Office.) [179]

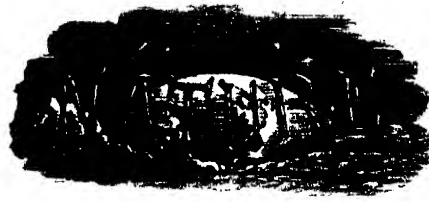
Malta. Annual Report on the Working of the Museum Department during 1936-37. Pp. xxvi. (Malta: Government Printing Office.) [179]

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Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LRSQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3545

SATURDAY, OCTOBER 9, 1937

Vol. 140

State Intervention and Agriculture

STATE intervention in a particular industry is one of those subjects which most probably would have been rejected by the Council of the British Association had it not happily decided to include within its ambit the interactions of science and the life of the people. It is true that this development tends to bring the sciences into closer touch with economics and politics, but one day economics may be established as a fully inductive science, and knowledge obtained by impartial scientific inquiry will be the basis of political action.

State intervention is increasing everywhere, and for reasons which are not far to seek. Industrial and social relations generally have multiplied so greatly and become so exceedingly complex that only a supreme authority can co-ordinate them. An industrial system based upon the law of the jungle is no longer regarded either as ethical or efficient. Morality has not kept pace with material progress, and the basest uses are being made of some of the fruits of science and invention. The view that the functions of the State should be restricted to protecting its citizens against external aggression and maintaining justice between them is still valid if we accept a wider connotation of the word 'justice'. Probably most of us now consider it right that the State should control the conditions of industrial competition; that it should abolish privilege as a right to which no corresponding function is attached; that it should so far as possible give equal opportunity to all; and many think that it should secure to every worthy citizen a sufficiency of the basic necessities of life—wholesome food, clothing, shelter and facilities for re-creating mind and body.

Opposed to this growing recognition of the need for extended State action is the inborn longing

for individual freedom, and one of the major problems of civilization is how to reconcile the freedom required for individual development and self-expression with the restraints which the State must impose to save itself from anarchy and disruption, and to give every citizen a fair deal. No one with any faith in the future believes that these two ideals are fundamentally incompatible. Science, art and industry provide the knowledge and the means for attaining a full, free and happy life; and yet it eludes us—probably because the necessary emotional stimulus is lacking. The older religions no longer seem able to impart this stimulus. Can devotion to high ideals of conduct and attainment take their place? Man began by being a slave to his environment; he acquired the elements of freedom when he learned to adapt himself to it, and to co-operate with his fellows; his freedom grew as science taught him how, in a measure, to control his environment; it will grow still more as he learns to control himself and develop a social conscience. Laissez-faire is on its death-bed; State intervention, regulative, controlling or dominating is taking its place. To many it is a necessary evil, but it will persist so long as individuals and communities play a lone or selfish hand. The ecclesiastics who demand a 'change of heart' are right: "The solid ground of nature"—like patriotism—is not enough.

The incongruity of State regulation or control and personal freedom, in relation to agriculture, was well brought out by Mr. J. M. Caie in his presidential address to Section M (Agriculture) of the British Association. As assistant secretary to the Department of Agriculture for Scotland, his pronouncements were necessarily guarded, but it was clear that, although he recognizes the

inevitability of State intervention in existing circumstances, he deplores its extension, believing with the fourteenth century poet, Barbour, that "Freedom is ane noble thing". Liberation, if only partial, waits on the return of economic prosperity, and the road thereto lies in securing for farmers a fair share of the home market, and in inducing them to eat of the fruits of education and research. The personal factor, he is convinced, is still extremely important, and the progressive farmer is usually the last to seek aid from the State.

The trouble here is that it has always been found difficult to induce farmers, as a class, to adopt the innovations indicated by scientific research (Australian farmers took to the use of superphosphate twenty-five years after its value had been demonstrated). Great Britain possesses some research institutions of the highest class and a goodly number of well-equipped agricultural colleges and farm institutes, yet farmers fail to take full advantage of them. We have some of the best farmers in the world, but, according to high authorities, our general standard of farming is relatively low. In recent years farmers have had to contend with very low prices for their produce, and many of them have not been able to afford the purchase of new equipment; but prices are now better, and the time now appears opportune for making an organized effort to 'put over' to the rank and file of farmers the practical results of recent research. Farm-equipment, seed-dressing, grassland management, fertilizers and composts, ensilage, grass-drying, and farm accountancy are all subjects in which progress has been made and to which the farmers' attention should be directed. This question is of very wide import and might well be discussed at a future meeting of Section M.

No one will deny that the Ministry of Agriculture has been alive to the hardships and responsive to the importunities of farmers; with its aid the production of sugar-beet has increased from 102,000 tons in 1923 to 3½ million tons in 1936-7, and that of wheat by 44 per cent since 1932. It is now extending its protection to growers of barley and oats, and—what is more important—is coming to grips with the fundamental problems of maintaining the fertility of the soil, by paying half the delivered cost of lime and one quarter that of basic slag; and improving the health of livestock, by instituting a vastly extended veterinary service. Less directly, the Government has assisted agriculture by fathering the establishment of marketing boards for milk, potatoes, hops and bacon, and of

a commission for fat cattle. These boards have, in the main, succeeded in enabling producers to get better prices, in mitigating the effects of violent price fluctuations, and in controlling the quality of certain marketed produce. On the other hand, some of the schemes are exceedingly complicated and require an army of officials and employees to work them, whilst the criticism is often heard that consumers' interests have not been adequately safeguarded; for example, the price of milk for liquid consumption is held to be excessive. In Germany the cost of distributing milk is stated to be only about one half of what it is in Great Britain, so that by adopting a system of State control from cow to consumer similar to the German, we might save £10,000,000 a year on this item alone. Nothing appears to have been done to reduce the lamentable 'spread' between producers' and consumers' prices, and the conviction is growing that the Government must be driven to tackle the general problem of distribution and consumption, and to institute a census forthwith.

So far governmental efforts have appeared to concentrate on symptoms and palliatives rather than on radical cures, and legislation has been too piecemeal. Desperate diseases require desperate remedies, and that no doubt is one reason why Sir Daniel Hall, in the inter-sectional discussion at Nottingham on "Planning the Land of Britain", advocated the nationalization of the land, and why Prof. R. G. Stapledon has come reluctantly to the same conclusion in regard to the improvement of our upland pastures. Another urgent problem the solution of which is defying the efforts of the Government, is how to reconcile the demands of home farmers with those of producers in the self-governing Dominions; and no solution to the problem of increasing our supplies of home-grown food to make us secure in time of emergency is yet forthcoming.

These and other problems confronting agriculture and the community are of such magnitude and complexity that no one expects them to be resolved overnight. They transcend the ability of individuals and are therefore rightly passed on to the State. Many of them are of international moment, and most of them bear direct relation to the riddle of how to raise the purchasing power of the masses so as to give them a higher standard of life. The important thing is to rule out drift. Social change, like all change, is ineluctable, but it can be controlled and directed towards social betterment.

Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions

By

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A. J. Higgs and Dr. S. E. Williams, Commonwealth Solar Observatory, Canberra

FOR some months we have been recording daily the equivalent heights and reflection coefficients of the F_2 region of the ionosphere, for radio frequencies near to the critical penetration frequency of the region. Under these conditions, the

hours Eastern Australian Standard Time, is reproduced in Fig. 1. For reasons of lack of space, only the most marked period of the disturbance, between 0932 and 0955 is shown in the figure. The heights and intensities are recorded for

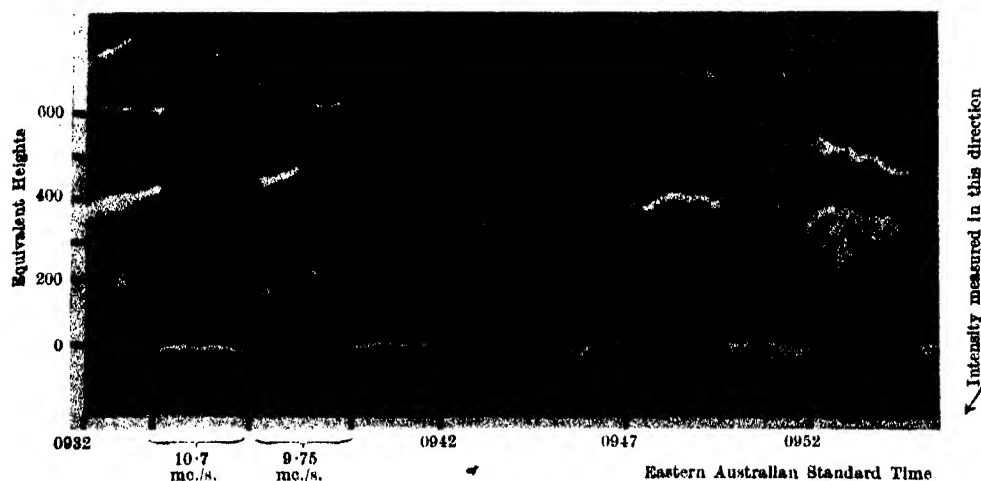


Fig. 1.

EFFECT OF BRIGHT HYDROGEN ERUPTION ON EQUIVALENT HEIGHTS AND ECHO INTENSITIES FROM F_2 REGION OF IONOSPHERE. VISUAL OBSERVATIONS WITH SPECTROHELIOSCOPE IN H_α SHOWED BRIGHT SPOT BETWEEN 0922 AND 0940 HOURS E.A.S.T.

recorded quantities are exceptionally sensitive to small changes in the electron density of the F_2 region.

Examination of our results reveals the frequent occurrence of a type of disturbance which has the following definite features:

(a) the equivalent height rises sharply in a period of a few minutes;

(b) the intensities of the reflected echoes decrease at the same time as (a);

(c) after some minutes the heights decrease and the intensities return to normal;

(d) although the disturbance may now be said to have ended, the F_2 region is left higher than before, although the F_2 electron density has returned to its original value, as evidenced by the separation of the ordinary and extraordinary magneto-ionic components, and other tests.

The record of a typical disturbance, which occurred on May 15, 1937, between 0920 and 1005

periods of $2\frac{1}{2}$ minutes each successively, on frequencies of 9.75 and 10.7 mc./sec. The ground wave appears along the lower edge of the diagram, its intensity being measured by the breadth of the trace downwards and to the left, according to a technique as yet unpublished. It is seen that the ground wave is very weak for the lower frequency, while at 0945 and 0950 the ground wave on the higher frequency appears specially strong. The latter circumstance is due to the observer increasing the sensitivity of the receiver in an unavailing attempt to record echoes at this frequency. At 0932 are seen strong echoes from the F_2 region at equivalent heights of 400 and 295 km. These are respectively the ordinary and extraordinary components into which the wave is split by magnetic double refraction in this region. The doubly reflected echoes are seen above. The intensities of these echoes are indicated in the manner described above for the ground wave.

It is seen that the equivalent heights rise steadily until 0948, when the ordinary wave has penetrated the region while the extraordinary echo is of much reduced intensity. At 0955 the intensity of the extraordinary component is almost normal, but the equivalent height is now 365 km., which is much greater than obtained before the disturbance commenced. The intensity of the ordinary component returned to its normal value at 0957, and the heights returned to normal at 1005. On three occasions, namely, at 1250-1330 April 24, 1140-1220 May 25, and 1200-1300 June 11, the disturbances, while exhibiting all the characteristic features described above, were so pronounced that echoes practically disappeared. On each of these occasions, reference to the La Perouse receiving station of Amalgamated Wireless Australasia, Ltd., revealed that a fade-out of all signals from short-wave transmitting stations throughout Australia had occurred, while only a few overseas transmitters were heard, with greatly reduced intensity.

It is clear, therefore, that so-called 'fade-outs' are due to particularly strong ionospheric disturbances of the type described above.

The non-return of echoes from the ionosphere can be due to (α) a reduction of the electron density in the reflecting region, or to (β) an increase of ionization in an absorbing region. It is clear from the above that (α) does not occur in the F_1 region. For example, the disappearance of echoes on the higher frequency in Fig. 1 must be due to this cause. Calculation by well-established methods¹, of the reduction of the reflection coefficient before penetration occurs, reveals, however, that the observed reduction of ionization in F_1 is not by itself sufficient to account for the observed reduction of echo intensity.

We have obtained further information on this point from records showing equivalent height-frequency curves, which have been obtained automatically at half-hourly intervals with equipment formerly described². On some occasions, when a disturbance has been observed in progress, the operation of this apparatus has been quickened, so that it measured the ionization densities of the various reflecting regions E_1 , E_2 , F_1 , F_2 at five-minute intervals. From the auxiliary data obtained in this way it has been found that almost simultaneously with the reduction of ionization in the F_1 region, there occurs an increase in the ionization of the absorbing D region below 100 km. This is clearly shown by the weakening, and occasional complete disappearance of the E (and F) echoes obtained on low frequencies, although these echoes may be received almost unimpaired on higher frequencies.

It has been shown by Dellinger³ and others that fade-outs sometimes occur almost simultaneously

with bright hydrogen eruptions on the solar disk, although only a small fraction of observed eruptions appear to be effective in this connexion. We find strong evidence that every solar eruption observed at the Commonwealth Solar Observatory occurs almost simultaneously with an ionospheric disturbance of the type described above, although only a fraction of these disturbances are large enough to cause a complete 'fade-out'. Thus of forty-four eruptions observed during March-June 1937, forty-one were observed or estimated to begin within ten minutes of the beginning of an ionospheric disturbance, while only three eruptions produced no observable disturbance. It is further to be observed that, in the latter three cases, the eruptions followed closely after the occurrence of an earlier eruption which did produce an ionospheric disturbance. It appears likely, therefore, that in each of these three instances the ionosphere had not recovered from the effects of the earlier disturbance sufficiently to respond to the second eruption.

It is clear that all these effects must be due to sudden bursts of ultra-violet radiation from the eruptive area on the solar disk. In many cases the results show that the normal D region ionization is more than doubled during an eruption, although the eruptive area may be less than $1/2,000$ of the solar disk. It is clear, therefore, that the effective ultra-violet radiation from the eruptive area increases by a factor of some thousands during an eruption. Observations with the spectrohelioscope during eruptions show that the intensity of the first emission line of the Balmer series of hydrogen (H_α) increases by a factor of about ten in the eruptive area, but similar observations in the ultra-violet are, of course, unobtainable owing to atmospheric absorption.

We find very strong evidence that the major effects produced in the ionosphere during an eruption are due to solar emission of the Lyman resonance line L_α (1215.6 Å.) of hydrogen, which must be emitted in great intensity from the eruptive area.

No hydrogen radiation other than L_α is capable of penetrating the earth's atmosphere to the depth of the D region, but Hopfield⁴ has shown that air has just the necessary transparency over a limited spectral region around the wave-length of L_α . Moreover, no solar radiation capable of directly ionizing oxygen or nitrogen is capable of penetrating to the D region. Chapman and Price⁵ have pointed out, however, that the oxygen atom in the 1S state resonates to L_α radiation (if a few angstroms wide) and is raised to the 1P state. If a collision occurs in this state, it can lose an electron and 0.75 electron volts, thus reverting to the normal

state of ionized atomic oxygen. For this to happen it is obviously necessary that the life-time of the atom in the 1P state must be comparable with, or greater than, the mean time interval between collisions. This condition is satisfied in the D region, where the electron collision frequency is approximately 5×10^7 per second. It is not likely to be satisfied in the E or higher regions, so that we should not expect increased ionization in these regions due to L_a radiation. The abundance of oxygen atoms in these regions is beyond doubt.

The decrease of ionization density in the F_2 region during an eruption is also explained by the great increase in L_a radiation. The radio data show conclusively that the region, and the atmosphere below to some yet undetermined level, is considerably heated and expanded during an eruption. This is evidenced by the pronounced rise in the real height of the F_2 region during an eruption, by the reduction of the density of the ionization in this region, by the comparatively rapid recovery of the F_2 ionization due to rapid cooling of the very hot F_2 region, and by the slower recovery of F_2 height due to the slower cooling of the less hot regions below. The work of G. H. Godfrey and W. L. Price, which is in course of publication, shows that in the absence of water vapour these regions would reach an equilibrium temperature of $3,200^\circ \text{K}$. due to the absorption by oxygen of solar ultra-violet radiation of wave-lengths about 1450 \AA . It is the presence of water vapour, in concentration of about one part in ten thousand by volume, which keeps the temperature down to the values between $1,000^\circ \text{K}$. and $2,000 \text{ K}$. which are found experimentally by Martyn and Pulley* in the F_2 region.

It has been recently shown by Rathenau† that water vapour shows strong absorption bands at the wave-length of L_a , such absorption leading to dissociation of the H_2O molecule into H and OH^* .

It is clear, therefore, that the strong L_a solar radiation during an eruption must dissociate much of the water vapour present in the upper atmosphere, so leading to higher equilibrium temperatures in the ionosphere. The application of Godfrey and Price's calculations shows that these temperatures are attained in a few minutes, and leads to a detailed explanation of the observed phenomena in the F_2 region during an eruption.

The origin of the numerous ionized levels of the ionosphere is still unknown, progress having been impeded by lack of knowledge of the solar radiation in the ultra-violet. The assumption of black body radiation in this region only increases the difficulties of interpretation by providing an infinite variety of ionizing radiation. It is a fortunate circumstance that the increased radiation during an eruption is confined to relatively few wave-lengths, with L_a almost certainly predominant. We believe that the study of the behaviour of the ionosphere while the sun is providing increased energy at these relatively few wave-lengths must greatly increase our knowledge of the normal structure of the ionosphere, and of the normal solar ultra-violet radiation. With this object in view we are now studying the effects of solar eruptions on the E_1 , E_2 , F_1 and G regions, in all of which smaller but appreciable changes occur.

This work is published by permission of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research, and of the director of the Commonwealth Solar Observatory.

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Geographical and Cultural Regions

A JOINT discussion between members of Section E (Geography) and Section H (Anthropology) was held at the British Association meeting at Nottingham on the subject of geographical and cultural regions. The primary object was to clarify the concepts of regional divisions of the earth's surface from various points of view.

A large measure of agreement on the fundamental principles of regional division from the point of view of the geographer was revealed. Its essential object is to distinguish different environments, and there was no divergence from the view that the most permanent contrasts, and those most

important in relation to human life, are determined by natural factors (position, physical features, structure, climate, soils and vegetation). The total complex of conditions characterizing the personality of any such 'environment region' is, however, in practically every case profoundly modified by man, who must himself be included as one of the creative factors. Entirely 'natural' regions are now comparatively rare; for example, it was pointed out that very little of the tropical forest of Africa is in a true sense primitive. Subject to this qualification, the concept of major natural regions, as worked out at the beginning of the century by

Prof. Herbertson of Oxford, is of great and lasting value.

It is important, however, to distinguish two aspects of regional division. Regional schemes such as that of Herbertson are *generic* in character. A type is defined, based on fundamental criteria of climate and other factors, and its distribution over the earth's surface examined. All the representatives of the type broadly resemble each other in these particular respects and their 'intrinsic conditions' are comparable. But generic classifications of this kind cannot take into account the factor of geographical orientation, which in its influence on the evolution of human societies and the moulding of the *genre de vie* is often quite as important as the intrinsic conditions. The Sahara and the Atacama in Herbertson's scheme both belong to the category of hot deserts; but the geographical position of the Sahara between the Mediterranean lands and tropical Africa has profoundly influenced the evolution of its trading societies and differentiated its human life from that of the Atacama. So, too, while there is a 'Mediterranean' type of climate, vegetation and production, which is found in five or six widely separated parts of the world, the Mediterranean region of the Old World in the sum total of its conditions and in its geographical setting has no real parallel elsewhere.

Thus, apart from generic classifications, the attempt is made by geographers to distinguish what may be termed *specific* regions with a particular location and a combination of conditions found nowhere else. There are different 'orders' of such regions, ranging from the *pays* of France (Beauce, Brie, etc.) to such large concepts as 'Western Europe'. When over wide areas there is found a particular set of intrinsic conditions in combination with a very definite geographical orientation, we have distinctive theatres of human life which are characterized by a series of closely linked physical and human phenomena. Examples of such large 'human provinces', if the phrase may be allowed, are North China (north of the great climatic, vegetational and economic divide of the Tsin-ling shan), the Lower Yang-tze Basin (below the Gorges) and South-East China (south and east of the Nan-ling and its continuations). In such attempts to define large specific regions it is often necessary to recognize transitional zones and to admit that human agency, as in the case of the North German Lowlands in recent times, may change considerably not only the intrinsic conditions but also the value of the geographical orientation.

The discussion at Nottingham on the concept of cultural regions and their relationship to geographical divisions of the earth's surface was mainly negative. On the ground that race,

religion and language are all unsatisfactory and dangerous as criteria, several of the anthropologists present were unwilling to admit the validity of the concept of cultural regions, except in respect of limited areas defined in terms of material culture-traits such as those which Mr. Clark Wissler has determined for aboriginal North America. Owing to its isolation and comparative immunity from new waves of cultural influence, Pre-Columbian North America presented a more favourable field than Asia or Africa for the establishment of relatively stable culture-complexes broadly corresponding to natural 'food-regions'. But even these passed through many phases and interacted in complex ways before the final disintegration caused by the advent of the white man.

Admitting the force of these contentions, the question remains whether it is not still legitimate and indeed important to distinguish regional types of civilization. A notable passage in Mr. R. F. Hudson's scholarly work on "Europe and China" is worth recalling:

"There is a hierarchy and ranking of nationalities in accordance with degrees of community or separateness in cultural inheritance. There is the supreme nationality which is mankind. Within this greatest whole are the few great unities formed by continuous dominant traditions of original civilisation, and within these again are the many lesser groups, determined mainly by present spoken language, which are the only 'nations' known in ordinary speech.

"Europe and China are nations of the first division of mankind: they are great continuities of historical development which may embrace many distinct languages and political units. . . . The real unity in each case has been one of cultural tradition. Europeans are all peoples and states deriving their dominant cultural form directly or indirectly from Hellenism, Chinese those deriving it from the 'Chinese' empire of the Hwang-ho basin in the first millennium B.C."

Is it denied that, in spite of the complexities and new ideologies of the modern world, there are still certain "great unities formed by continuous dominant traditions of original civilisation"? Is it no longer valid to make the distinction between the European and the Chinese type of civilization? Has not the real unity of China been in a broad sense 'cultural'? Or, if 'culture' must be used in a more restricted sense, what other term should be employed to express a unity that has been immensely powerful and yet has been neither national nor political? These questions may be asked with full consciousness of the intricacy of modern civilization and the possibility of rapid change in cultural affinities such as seems to be illustrated by the Turkish national State since the Great War.

P. M. ROXBY.

Chemistry of Building Materials

AT the meeting on September 7 of Section B (Chemistry) of the British Association, there was a symposium on "The Chemistry of Building Materials". After an introduction by Dr. R. E. Stradling (director of the Building Research Station), papers were presented by Dr. F. M. Lea (Building Research Station) on "Some Problems in the Study of Hydraulic Cements", Dr. J. S. Dunn (Imperial Chemical Industries, Ltd.) on "Calcium Sulphate Plasters; Setting, Retarders and Accelerators", Mr. F. H. Clews, Mr. H. H. Macey and Dr. G. R. Rigby (British Refractories Research Association) on "Some Important Properties of Clay", and Dr. D. G. R. Bonnell (Building Research Station) on "Some Problems connected with Porous Building Materials".

Building presents an excellent example of a traditional industry in the stage of transition to an applied science. It is an industry founded originally on craft and based on rules of experience which have become enshrined in traditional methods. To the older building materials such as timber, stone, burnt clay and lime, there has been added in modern times a host of new products, whilst the demand for speed and economy in building has resulted in numerous changes in methods. These changes have often been in the nature of extensions and modifications of traditional processes, but they have been made without that full knowledge of the reasons for the success of the traditional methods which is necessary if development is to have a sure basis and to be other than the slow and costly traditional method of trial and error. Modern conditions have necessitated, therefore, not only the examination of the newer materials and processes, but also the study of the traditional materials and of the reasons for the success of the traditional methods.

This is well exemplified in the craft of the plasterer. The production of lime was formerly a local industry, and the craft by long experience had become adapted to the properties of the local materials. The modern development of large-scale production has led to the wide distribution of materials which, though outwardly similar, differ in properties from those to which the craftsman was accustomed. Calcium sulphate plasters have been added as an additional plastering medium, but materials of this class, differing widely in properties, and in the methods necessary for their successful handling, are distributed under trade names giving no clue as to the type to which they belong. The substitution of Portland cement mortar for lime mortar in rendering and stucco,

again without adequate appreciation of the very different properties given to the finished product, has been a very common cause of trouble.

As was pointed out by Dr. Stradling, the craftsman in lime and plaster controls a chemical reaction of which he knows nothing. While working with materials in which he had long experience, the craftsman could produce excellent work; with materials of different physical properties and rates of reaction, however good these materials might be, there entered factors to which he was unaccustomed, and of which he had no warning, and his craft suffered in consequence.

The problems in building to-day are, however, not only due to insufficient knowledge of the fundamental properties of its materials of construction, but also, and in considerable degree, to insufficient dissemination of the existing knowledge among architects, builders, engineers and craftsmen. Whilst research on materials is now proceeding at a rapid rate in many countries, the need for further education in the building industry is only too clear.

The discussion at the meeting of Section B could inevitably only cover a small part of the field indicated by its title, but it sufficed to bring forward many interesting problems.

Apart from the metals and igneous rocks, all building materials are porous and capable of absorbing water to some extent. Changes in moisture content, not only on first drying, but also in subsequent use, produce accompanying changes in volume and in other physical properties such as strength and elasticity, while the movement of water, carrying soluble salts in solution, gives rise to surface efflorescence and to decay of masonry and brickwork. The change in volume is responsible for much of the cracking found in buildings. In practice it is relieved to some extent by the ability of materials to creep, or undergo plastic deformation under load. Though much work has been done on shrinkage and creep, there is still need for further study of moisture movements under conditions of restraint, such as normally occur in building. The general phenomenon of volume change in porous solids has as yet interested chemists relatively little though it offers a promising field for research. The work of Meehan and Bangham on the expansion of charcoal by sorption of gases and vapours is suggestive in this connexion.

Calcium sulphate plasters can be grouped generally into the hemihydrate and the anhydrite types, the latter being produced by the burning of gypsum

at relatively high temperatures or from the natural mineral. The system calcium sulphate-water is of the simplest binary type, but despite much work since Lavoisier's original contribution in 1765, the problem of the dehydration products of gypsum has never appeared fully solved. It has usually been considered that the partial dehydration of gypsum results in the formation of the hemihydrate, $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$, but Dr. Dunn reported that the crystal form of this compound remains unaffected, with but minor changes in the lattice constants, with water contents ranging from 0 to 0.65 molecules of water. It is considered probable, therefore, that there is a zeolitic series with $3\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and CaSO_4 as end members. Plasters containing the so-called hemihydrate usually require to be retarded as otherwise their rate of set is too rapid for normal use in building. Two types of retarder can be distinguished, one reducing the rate of nucleus formation and the other acting similarly, but, in addition, modifying the habit of the gypsum crystals, giving a relatively slower rate of growth along the *c* axis. The rate of set of anhydrite plasters is very slow and, in practice, an addition of an accelerator is required. In general the hydration is accelerated by sulphates of the alkali and other metals, but the most effective catalysts are those combining an alkali metal sulphate with the sulphate of another metal such as zinc, the effect being more than additive and an optimum ratio existing for the two sulphates. The alkali metals accelerate the growth of gypsum crystals most at right angles to the *c* axis, while zinc sulphate is more specific for growth parallel to that axis. This observation takes the explanation of the action of a two-component catalyst one stage forward, but the problem of how each catalyst stimulates crystal growth still remains.

Though the most obvious property required in a cement is that of developing strength, in practice this presents few problems compared with those arising from volume change and physical and chemical decay. The heat of hydration of Portland cement, which may amount to a hundred calories per gram, is a source of considerable trouble in concrete structures of large mass. The internal temperature in concrete dams, for example, may rise as much as 50°C . above the original temperature of the materials, and the thermal contraction which takes place during subsequent cooling is the main cause of cracking in such structures. The production of cements with a reduced heat of hydration, and their utilization in recent work, such as Boulder Dam on the Colorado River, U.S.A., can be traced back to the much increased knowledge of the constitution of Portland cement which has resulted from phase equilibrium studies on many of the oxide systems involved.

The relative properties of vitreous and crystalline phases of the same gross composition is a matter of much interest in cement technology at the present time. During the burning of Portland cement, some 20-30 per cent of the mass passes into the liquid condition, but the extent to which this liquid crystallizes on cooling, or supercools to form a glass, probably varies considerably. There is evidence that unexplained differences in properties of cements of similar composition and fineness may have their origin in variations of this kind.

Clay is amongst the oldest of the raw materials of building and it has been successfully moulded, burnt and used for some thousands of years without any scientific knowledge of its chemical constitution or physical properties. A certain degree of control was, however, formerly exercised by Acts of Parliament. In 1477, in the reign of Edward IV, an Act required that the clay should be dug before November 1, turned over before February 1 and not used before March 1. Even so late as the reign of George III, there came an added requirement that the clay should be turned between February 1 and the time of moulding of the bricks. The reduction or, in some cases, entire elimination of the time of weathering of the raw clay, together with the speeding-up of drying and other processes, have created many new technical problems. The large-scale production of burnt clay products demands, therefore, if it is to be conducted on economic lines, a degree of control both of materials and processes which was quite foreign to the older small-scale industry.

The mineralogy of raw clay has made striking advances in recent years, but the chemical changes which occur on burning are still a matter of controversy. Plasticity, that physical property by which clays are characterized, remains a much confused subject. In many of the experimental methods used for its determination in the clay industry, properties other than plasticity enter, and a return to methods which are fundamentally simple, such as the measurement of deformation in torsion or tension, appears necessary. Problems of drying play a large part in manufacture, and most manufacturers use unnecessarily long drying periods as an insurance against losses by cracking. This could be avoided by the application of adequate knowledge of the properties of a clay. The temperature of drying is important, there being a temperature at which the safe rate of drying is a maximum; the tendency to crack is greater above and below this temperature. It appears that the decrease in viscosity of water with rise in temperature is offset at the higher temperatures by the decrease in the tensile strength of the clay.

F. M. L.

The British Association and the Indian Science Congress

A Scientific Delegation to India

ARRANGEMENTS for a scientific delegation from Great Britain to India this winter are nearing completion. The Indian Science Congress Association, which holds annual meetings in different parts of India of individual scientific workers and others, and functions much on the lines of the British Association for the Advancement of Science, is approaching the celebration of its jubilee (twenty-fifth) session at the meeting to be held in Calcutta in January next. The Association invited the co-operation of the British Association in forming a representative visiting delegation from this country and others, and the General Committee of the British Association eagerly accepted the invitation, which was, in effect, to make a new use of the mechanism of the Association, and one which is felt to suggest far-reaching implications. It is common knowledge that the British Association has sometimes held its own annual meetings overseas, at the invitation of Dominion Governments and institutions. But it has never before been asked to co-operate in organizing a scientific delegation apart from its own annual meetings—and if this can be done for India, why not for other parts of the Empire in which conditions would not permit of a meeting of the Association on ordinary lines? But this is to anticipate: the present notice is concerned with the Indian meeting.

It was arranged with the Indian Science Congress Association that invitations should be extended, through and by the British Association, to a large number of eminent scientific workers in Great Britain, in part on nominations received from India, and for the rest on representative standing in the British Association. The Indian Association itself has invited certain representatives from foreign countries, and also from Great Britain in a few departments of work which find more prominent places in the Indian Association than in our own. Lord Rutherford accepted the Indian Association's request to preside over the joint congress, to the immense satisfaction of both British and Indian colleagues. The total number of the party, including delegates and persons accompanying them, is 94 at the moment of writing; but this is subject to some addition—not, it is to be hoped, to subtraction.

The programme in India is being arranged by the Indian Science Congress Association, and the presidents of the sections for the meeting are all residents in India; but the visiting delegates may

be expected to take an active part in the proceedings. The meeting in Calcutta will run from January 3 until January 9, and will be preceded and followed by tours through India, during which visits will be paid to various university and other centres of scientific interest, and it is understood that some of the visiting delegates will be invited to lecture.

The great majority of the visiting party will sail on the P. and O. steamer *Cathay* on November 28 (or will overtake her at Marseilles by leaving London on December 2) and are due at Bombay on December 16. Two days will be devoted there to reception and sight-seeing, and the party will then leave in a special train or trains in which they will live, strenuously no doubt but in the best of comfort which the Indian railways can provide, for the next twelve days. In the course of this journey they will visit Hyderabad (by the special invitation of the Nizam's Government), Agra, Delhi, Dehra Dun, and Benares, besides intermediate points of interest, where scientific and university institutions in particular will be inspected. There will be some opportunity for short journeys from Calcutta before the meeting of the Congress, including field excursions to the coalfields, Tatanagar, Darjeeling, ancient 'Gaur', the Sundarbans and the Assam oilfields, and after the meeting a further tour is planned to include Madras and Bangalore. Many of the delegation, however, having special interests and contacts in India, will substitute for this second tour individual visits to various places, and full facilities will be given to them to do so. Nor will the whole party be gathered together for the homeward voyage, though a substantial proportion of it will return from Bombay on the S.S. *Strathaird*, which will bring passengers to England on February 3, or a few days earlier by the overland journey from Marseilles.

The fund necessary in connexion with this occasion has been raised partly by the Indian Association, partly by the British Association from interested firms and individuals at home, and partly by means of a contribution from the funds of the British Association itself, which last is additional evidence, if any were needed, of the full appreciation of the importance of the occasion by the Council and General Committee of the senior body, as well as of the high compliment paid to it by the Indian Association in inviting its co-operation.

Obituary Notices

Prof. V. L. Kellogg

IN the death of Vernon Lyman Kellogg, which took place at Hartford sanatorium (Conn.) on August 8 last, the United States loses an eminent citizen and one who was a leading figure in the scientific life of that country. Born at Emporia, Kansas, in 1867, he graduated at the University of Kansas in 1889 and at Cornell University in 1891. His academic training was primarily as a zoologist and was continued in Paris and in Leipzig.

Although a man of broad zoological interests, Kellogg's scientific papers were almost entirely concerned with entomology. For a few years he taught that branch of the subject at Kansas University and afterwards he became professor of entomology and lecturer in bionomics at Stanford University. In 1908 he married Miss Charlotte Hoffman of Oakland, California. During his long period of tenure at Stanford, he was closely associated with the late David Starr Jordan, in collaboration with whom he wrote several books on diverse aspects of general zoology.

Kellogg's career at Stanford University virtually came to an end with the advent of the Great War. It was through the influence of Herbert Hoover that Kellogg was seconded for work in connexion with the American Relief Commission in Europe. Here his organizing capacity found scope, and he rapidly came into prominence owing to the leading part he performed in the Commission's activities. From 1917 until 1919 he was director in Brussels of this Commission for Belgium. His labours, on behalf of the benevolent efforts made by the United States, took him also to Poland and to Russia. The services which he rendered in organizing relief and other measures, during and after the War, received recognition by the bestowal upon him of decorations by France, Belgium and Poland.

On returning to the United States, Kellogg resigned his position at Stanford University, which he had held from 1894 until 1920. He had lately become permanent secretary of the National Research Council, an office which he administered until he retired from the post at the end of 1931. Kellogg's main interests were no longer in academic work, and he embarked upon what had been described as his period of greatest influence and accomplishment. In his capacity as secretary he played a major part in organizing the National Research Council. Being also a member of the National Academy of Sciences, a trustee of the Rockefeller Foundation and a member of its executive committee, and of other bodies, he was able to do much towards moulding the trend of scientific activities in America. Prof. R. A. Millikan, writing in *Science* of September 3, recounts that about 1930 Kellogg found himself to be the victim of an incurable malady known as Parkinson's disease (*paralysis agitans*). The fortitude with which he

faced this sentence, with unimpaired mind and failing body, won the admiration of personal friends. He only missed by a few months attaining his seventieth birthday.

Kellogg's contributions to entomology were in taxonomy and anatomy. For a number of years he was the leading authority on bird parasites or Mallophaga. His other papers were chiefly concerned with the structure of Diptera, and he also made a special study of the family Blepharoceridae and their larvæ. His monograph on this group, and also that on the Mallophaga, formed parts of the "Genera Insectorum". His writings also include anatomical and other articles on Lepidoptera. Most of his papers were short, but they usually brought to light new or interesting features. His books were of a more general character and included "American Insects", 1904; "Evolution and Animal Life" (with D. S. Jordan), 1907; "Darwinism To-day", 1907; "Economic Zoology and Entomology" (with R. W. Doane), 1915; "Mind and Heredity", 1923; "Evolution", 1924, and several others.

During the War years, and shortly afterwards, Kellogg wrote various books of a different character—they were incidental to that upheaval in Europe and had particular reference to its political and economic outcome. These writings made his name familiar among his countrymen as that of a notable exponent of those times.

A. D. IMMS.

Mr. F. C. Thompson

FREDERICK CHARLES THOMPSON, lecturer in the Leather Industries Department and research assistant in the Procter International Research Laboratory of the University of Leeds, died on September 4 at the age of forty-six years. He received his early education in a Leeds secondary school and then followed the honours course in pure chemistry at the University of Leeds, graduating in 1911. Two years later he obtained an honours degree in the chemistry of leather manufacture, and in the same year was appointed to the staff of the Leather Industries Department as assistant lecturer and demonstrator under the late Prof. H. R. Procter.

In 1913, Mr. Thompson became research assistant in the Procter International Laboratory and in 1923 was made a lecturer in the Leather Industries Department. He carried out a great variety of investigations on subjects connected with the applications of protein chemistry to leather manufacture independently and in association with Prof. H. R. Procter, Prof. D. McCandlish and Mr. W. R. Atkin, a fellow lecturer in the Department. Recently, in collaboration with Mr. Atkin, he re-wrote Procter's "Leather Chemists Pocket Book", and this revised enlarged edition is generally regarded as the standard analytical text-book for the leather chemist.

Mr. Thompson was an authority on the application to problems of the leather trade, of electrometric and colorimetric titration of reactions and was frequently consulted by workers in other branches of applied science. In recent years he collaborated with Dr. J. Gordon of the Leeds Medical School in research work upon the complex subject of immunity, where Mr. Thompson's knowledge of protein chemistry proved useful, and several joint papers have been published by them in the *British Journal of Experimental Pathology*.

Mr. Thompson enjoyed the complete confidence of his colleagues in the International Society of Leather Trades' Chemists—an organization with branches in almost every civilized country in the world. After occupying many responsible positions as chairman of commissions, he became president of the Society in 1932 and held the office for two years. One notable contribution to the work of the Society which has earned the lasting gratitude of leather chemists was made jointly with his colleague Mr. W. R. Atkin. For many years difficulty had been experienced in scouring uniform supplies of hide powder, an essential material for the quantitative estimation of tannin in tanning materials used commercially. By their joint research, Thompson and Atkin established the cause of this variation and showed how it might be readily overcome. As a result of this work, far greater concordance of results is now secured in quantitative tannin analysis than was previously possible.

Mr. Thompson was a tutor of the University of Leeds, and for several years had been a member of the local committee of the Association of University Teachers. He had many interests outside university life—chief amongst them being welfare work amongst boys. He holds the record for longest continuous service with the Boys' Brigade in Leeds. Under his captaincy his Company won all the trophies open to competition, and held the battalion ambulance cup continuously for twenty-three years. For many years he was superintendent of the Burley Methodist Church Sunday School. He was interested in music and his ability as a violinist resulted in his association with several amateur orchestras. In 1919 he married Miss M. Hampshire, and she survives him.

D. McC.

Prof. A. W. Gibb

PROF. A. W. GIBB, first Kilgour professor of geology in the University of Aberdeen, died on July 12 at the age of seventy-three years.

Alfred William Gibb was born and educated in Aberdeen. After taking the degree of master of arts at the University of Aberdeen, he spent some years in teaching and in business before resuming his studies. He was one of the first to graduate at Aberdeen with the newly established degree of bachelor of science, and soon after he became assistant to the professor of natural history. In Aberdeen at this time, 1890, the teaching of geology and zoology was carried on in the one department. Fortunately, the interests of the professor, Henry Alleyne Nicholson, were keenly palaeontological and his enthusiasm and care in developing the geological side of his teaching

were shared by his assistant. When the late Sir J. Arthur Thomson succeeded Nicholson, he left the geology teaching entirely to Gibb. In 1908, a lectureship independent of the Natural History Department was established, and in 1922, the Kilgour chair of geology was founded. To each, in turn, Gibb was appointed, and he was responsible for the planning and development of the Department of Geology in Marischal College.

Instruction in the mineralogical and petrological aspects of geology was Prof. Gibb's personal responsibility. To this end, he spent his spare time studying with Miers and Judd, and in Heidelberg with Rosenbusch. In 1908 he was awarded a doctorate in science for a thesis describing the rocks of the basic complex of Belhelvie, and he communicated several papers on diverse aspects of local geology to the Geological Society of Edinburgh.

Prof. Gibb's main interest was his 'ordinary' class, the first-year class for arts and science students. His lectures were extraordinarily popular, vying with those of his colleague, J. Arthur Thomson, and infecting generations of students with a vital interest in the subject which he expounded with such fascination. He had been teaching for forty years when he was forced by ill-health to retire in 1936, and the news of his death will be received with the regret that he was unable to enjoy fully the peace of his retirement.

Prof. A. Heim, For. Mem. R.S.

A CORRESPONDENT writes:

"Though his name will always be associated with his studies on Alpine structure, the part of Prof. Albert Heim as the founder of the Swiss Seismological Commission deserves to be remembered. In 1878, the first year of its existence, the Commission consisted of seven members, with Prof. A. Forster of Bern as president and Heim as secretary. To Heim was also assigned the task of collecting observations from Zurich, Uri and other cantons. Though its work was taken over in 1913 by the Swiss Meteorological Office, the Commission, re-named as the Swiss Earthquake Service, may claim to be the oldest, and by no means the least useful, of all existing committees for the study of earthquakes."

WE regret to announce the following deaths:

Major B. F. S. Baden-Powell, known for his pioneer work in aeronautics, formerly president of the Royal Aeronautical Society, on October 3, aged seventy-seven years.

Mr. Richard Inwards, a former president of the Royal Meteorological Society, on September 30, aged ninety-seven years.

Mr. Arthur Kitson, who was early associated with electric lighting and the telephone, and invented the Kitson light, among numerous other devices, aged seventy-eight years.

Prof. W. St. Clair Symmers, emeritus professor of pathology in the Queen's University, Belfast, on October 4, aged seventy-four years.

News and Views

Biometry at University College, London

FROM the beginning of the present session, Prof. J. B. S. Haldane changes his duties by taking on those of the first Weldon professor of biometry, and he is the first holder of a chair in the subject at any British university. The post was founded by a bequest left last year by Mrs. F. J. Weldon in memory of her husband, Prof. W. F. R. Weldon, who was one of the original editors of *Biometrika*. Prof. Haldane will give the first of a course of ten lectures on biometry at 5 p.m. on October 12. In 1895 Karl Pearson gave his first course on the mathematical theory of statistics at University College, when he was professor of applied mathematics and mechanics. The Biometric Laboratory originated at this time. In 1907 he took over the Eugenics Laboratory from Sir Francis Galton. On his death two years later, the latter left the residue of his estate for the founding of a professorship and Laboratory of National Eugenics and Karl Pearson became the first Galton professor. For the next twenty years, research and teaching in eugenics, statistics and biometry were carried out in the same Department, known as that of Applied Statistics. On the retirement of the director in 1933, separate departments for the first two of these subjects were instituted, and there are now chairs for all three at the College where they first obtained academic recognition.

Ionospheric Disturbances and Solar Eruptions

DR. D. F. MARTYN, Messrs. G. H. Munro and A. J. Higgs, and Dr. S. E. Williams, in a communication which appears on page 603, show evidence that a type of ionospheric disturbance accompanies every bright hydrogen solar eruption. The main features of the disturbance are an increase of ionization in the *D* region and a heating effect in and below the *F*₁ region. When the disturbances are large they cause 'fade-outs' in short-wave communication. It is concluded that these effects are due to a greatly increased emission of the hydrogen resonance line *L*_α from the eruptive area. This causes ionization of atomic oxygen in the *D* region, and dissociates the water vapour in the *F*₁ region, thus raising the equilibrium temperature. Further evidence of a connexion between solar activity and short-wave radio 'fade-outs' is given in the note entitled "An Active Sun-spot" on page 616 of this issue.

A New Permanent Water-Repellant for Textiles

A NEW compound of exceptional interest to both chemists and textile manufacturers is the subject of an exhibition housed at Dorland House, S.W.1, on October 5-8. This preparation, which has been given the name "Velan", has been developed during the past three years at the Manchester laboratories of Imperial Chemical Industries, Ltd., as a universal water-proofing agent for textile goods. Information

concerning the chemical composition of Velan is not yet available, but it would appear to be a complex organic substance which reacts with both hydroxyl and amino groups and on that account is able to combine with both animal and vegetable fibres. For the impregnation of textiles, Velan is used in the form of aqueous dispersions, which are readily preparable from the substance without the aid of supplementary agents. The impregnated fabrics are dried, and combination between the reagent and the textile fibres is afterwards effected by heating at a temperature of 100°-150° C. It is the last stage of the process which gives permanence to the proofing.

VELAN is claimed to be the first water-repellant for textiles which will remain permanent during repeated washing, laundering and dry-cleaning processes. Further, the compound is said to be unique among proofing agents in that it imparts softness and suppleness to fabrics. Unlike rubber or cellulose lacquer waterproofings, Velan does not affect the interstices of textiles and render them impermeable to air. The proofing process has proved satisfactory with cotton, wool, natural and artificial silk, straw, etc., though cotton seems to be somewhat more satisfactory than other textiles from the point of view of the permanence of the proofing. In view of these advantages, and the fact that processing does not add greatly to the cost of manufacture, Velan should find a wide range of applications in the textile industries.

Aid for Intellectual Unemployed in France

INTELLECTUAL workers, including men of science, writers, artists and others, have suffered no less than industrial workers during the recent years of economic unrest. In 1934 an organization was established in France with the object of providing socially useful work for the unemployed professional men and women. A list of work to be done was prepared and private donations were obtained to support the enterprise in order to see whether the idea had a practical value. Thus, in 1934 and 1935 a considerable number of unemployed were engaged in preparing a complete list of benevolent associations existing in France since 1901. The "Confédération des travailleurs intellectuels", consisting of more than 200,000 workers from various professional groups, also had the problem of intellectual unemployment under consideration. "L'Entr'aide des Travailleurs Intellectuels" (E.T.I.) was organized in order to examine the situation and to find ways and means of giving efficient assistance. The poor financial state of France excluded all possibility of help from the Government, and it was impossible to rely upon private donations. A campaign was therefore begun to obtain from the authorities permission to issue special stamps of different values, with a small surcharge, the surcharge being destined for the intellectual unemployed. The

campaign succeeded in obtaining a resolution published in the *Journal Officiel* on May 27, 1936, by which the issue of special stamps was confirmed, and the E.T.I. was entrusted with the receipt and distribution of the funds collected, under conditions drawn up by the council of the E.T.I., the Minister of National Education and the Postmaster-General.

It was considered more useful to spend the money on work in science, literature and art, than in distributing doles, the work being carried on so long as the funds permitted under approved conditions. The work thus provided may not, of course, be adapted to the special qualifications of every unemployed person, but they are engaged for six months to do some socially useful work, unless they find employment in their own field. Up to January 1, 1937, the French Post Office paid over to the E.T.I. about a million francs under this scheme. This sum is due mainly to philatelists and stamp-dealers; for the success of the scheme, it is necessary that the public generally should take part in this social and humane work. At present the following stamps have been issued:



Fig. 1.

Letters abroad:

1 fr. 50 c. surcharge 50 c. (see Fig. 1)

Post-cards abroad:

90 c. „ 10 c.

Internal correspondence:

50 c. „ 10 c. and 20 c.

(three kinds of stamp)

30 c. „ 10 c.

These special stamps are available at any post office in France and at the E.T.I. (12 rue Henner, Paris IX), where they can be supplied in any quantity required.

Ancient Monuments in France

At the close of September the Commission des Monuments Historiques of France completed a hundred years of its existence. Although at one time subjected to no little criticism, instructed and otherwise, since the War, when it has included among its members the most distinguished of French archaeologists, its activities, both in the preservation and protection of buildings of historic interest and in its care for the antiquities of France generally, have deserved the highest praise. Notwithstanding limitations, of which the members of the Commission are even more fully conscious than expert opinion among the outside public, its control, advice and assistance in bringing to light, preserving and making

accessible the evidence from the prehistoric sites of France, which is now a world-wide possession of archaeological science, has earned the gratitude of every student of antiquity. Even better known to the travelling public, however, are the efforts which have preserved from decay and no less from vandalism the structures of the Middle Ages and of the Roman period. Among the latter the wonderful series of monuments of Roman culture, such as those at Orange, at Nîmes and at Arles, can never be forgotten by anyone who has passed through Provence. Among the latest achievements of the Commission is the excavation of the Roman theatre of Vienne, south of Lyons, which is not an amphitheatre of the more usual type, but is cut out of the side of the hill and necessitated an excavation more than sixty feet deep to bring to light the lowest tier of seats. The completion of the excavation is to be celebrated by a number of theatrical performances to be given on the stage next year similar to those now given annually in the amphitheatre at Orange.

'Shiva's Temple', Arizona

DR. HAROLD ANTHONY, leader of the Patterson-American Museum Grand Canyon Expedition, on his return to New York, gave a preliminary account of the results obtained during his four days' stay on September 16-20 on the summit of Shiva's Temple in the Grand Canyon, Arizona (see *NATURE*, Sept. 25, p. 537). Some seventy-five specimens, it is stated in the report in *The Times* of September 30, were shot or trapped, and will be forwarded to New York for examination. They include chipmunks, three or four species of mice, cottontail rabbits, rock squirrels, which resemble the common grey squirrel, and pack rats, of which one species may be peculiar to Shiva's Temple. As regards the problem whether isolation has produced any marked changes in appearance and habits, Dr. Anthony is of opinion that the colour of the specimens as a whole is lighter than that of those on the north and south rims of the Canyon, respectively one and a half miles and eight miles away in a straight line; but confirmation by detailed comparison is awaited. The vegetation, consisting of pines, junipers, shrubs, and cactus, is described as "more arid" than that of the mainland, and the heat as greater. The plateau, it is stated, is evidently visited in winter by cougar, or mountain lion, and coyote. As the report refers to the discovery of many Indian remains in the shape of mounds, ovens and tools, presumably the members of the expedition were not the only visitors to reach the summit since its isolation from the mainland, as was claimed originally, and the expectation of evidence bearing on the high antiquity of man in this region seems doomed to disappointment. Nevertheless, it is to be concluded that the remains are 'early', and any material which affords evidence of cultural or racial succession in the south-western States is of importance, especially in the present state of knowledge. It may be hoped that an opportunity will be found to submit the material *in situ* to careful and expert examination.

Broadcasting in India

AN outline of the policy and plans of the broadcasting organization known as All India Radio for the erection of broadcasting stations in India was given in a recent issue of the *Indian Listener*. The two main features of the problem of providing a broadcasting service in India are the relatively large area of country to be covered, and the intense atmospheric interference. It is considered to be desirable to provide as quickly as possible some sort of broadcasting service for the whole area of India, and with this object in view five short-wave transmitting equipments have been ordered and will be located at Delhi (two stations), Bombay, Calcutta and Madras. At the same time, five medium-wave stations have been ordered to provide a first-grade broadcasting service for the towns of Lahore, Lucknow, Trichinopoly, Dacca and Madras. These will supplement the existing medium-wave stations at Delhi, Bombay, Calcutta and Peshawar, so that shortly All-India Radio will have in operation five short-wave and nine medium-wave stations, the aerial power ratings of these varying from 0.25 to 10 kw. Bearing in mind that, in contrast with the practice in other countries, the short-wave stations have to provide an internal service in India, the operating wave-lengths will probably be between 30 and 50 metres for daytime and between 60 and 90 metres for night working. It is considered unlikely that there will be any interference between these stations working an internal service in India, and European and other short-wave stations operating an international service. The new medium-wave stations will operate on wave-lengths between 200 and 400 metres and will have large frequency separation so as to facilitate the provision of simple cheap receivers.

At the present time the position with regard to broadcasting receivers in India is unsatisfactory owing to their high cost. It is considered that with the development of transmitting stations now being undertaken, there will shortly be room for three types of receiver. The first is a cheap, popular receiver suitable for local reception from the medium-wave stations. Next comes the "All-India" receiver suitable for receiving all the stations now in contemplation, and thus capable of covering the short-wave band of 30-100 metres as well as the normal medium-wave band of 200-550 metres. The third type of receiver is in the "all-wave" class generally available at the present time in Great Britain, except that it should cover wave-lengths from 13 to 100 metres without a gap. In addition, there is a demand in India for wireless receivers suitable for community reception in villages, and the Research Department of All-India Radio has already developed a special set for this purpose. No external controls are provided on this receiver, which is left tuned to the local station and is operated by a clockwork time-switch, which turns the receiver on and off at the correct time for the "village hour". The only attention required by these receivers is a visit once every three weeks to change the accumulator battery and re-wind the clock.

Origins of Clerk Maxwell's Electric Ideas

A book entitled "Origins of Clerk Maxwell's Electric Ideas as described in Familiar Letters to William Thomson" has been published by the Cambridge University Press (price 3s. 6d.). These letters cover the period 1854-79 and illustrate clearly the genesis and rapid progress of Clerk Maxwell's ideas as he groped his way towards a structural theory of the electric and magnetic field. Some of the questions he asks Thomson are by no means easy to answer. In his first letter (Feb. 1854) he asks: "Suppose a man to have a popular knowledge of electrical show experiments and a little antipathy to Murphy's Electricity, how ought he to proceed in reading and working so as to get a little insight into the subject which may be of use to him in further reading?" In subsequent letters he continues to ask still more intricate questions, so doubtless Thomson's answers must have been satisfactory. In another letter he says, "I do not know the game laws and patent laws of science . . . but I certainly intend to poach among your electrical images". He fully appreciates Thomson's problem of an electrified spherical bowl. "Your bowl investigations are first-rate. I must find the induction through a round hole in a plate by means of them. Whether would you have me bag the whole thing for my book, or give results and references with an account of the method?" The letters given in this book were originally printed in Part 5 of vol. 32 of the *Proceedings of the Cambridge Philosophical Society*. As they will be of interest to many mathematical physicists, the Cambridge Press did well to publish them. Sir Joseph Larmor has edited the book.

Clean Milk and Pasteurization

DR. G. ARBOUR-STEPHENS, of 61 Walter Road, Swansea, writes, with reference to the article on the nutritive value of pasteurized milk (*NATURE*, 140, 389; 1937), that it is not justifiable to compromise a diminution of value in order to prevent the effects of handling by dirty people. Unfortunately, the problem is scarcely as simple as this: in spite of the greatest care and cleanliness in handling the milk, it cannot always be possible to prevent contamination from organisms which may have produced no obvious illness in the worker himself, but yet may be capable of producing illness in other people, or from organisms which may be disseminated during the incubation period of an infectious disease and before the symptoms have become obvious. To prevent otherwise unavoidable outbreaks of infectious diseases among the consumers of milk is the true function of pasteurization: it is certainly not to be considered as allowing the production of dirty milk, which can then be rendered innocuous before consumption. The aim should surely be the production of clean milk from disease-free herds, with pasteurization to obviate the ill-effects of any lapse in technique, which is bound to happen occasionally considering the many stages through which the milk has to pass under modern conditions before it reaches the consumer, or to prevent the accidental entry of virulent organisms.

Practical Aspects of Human Nutrition

THE text of a lecture entitled "The Place of Vegetables and Fruit in the Well-balanced Diet", which was delivered before the Royal Horticultural Society by Dr. G. E. Friend, is printed in the Society's *Journal* of July (62, 7, 286-295). A review of modern conceptions of the nutritional needs of the human body dealt principally with the quality of diet, rather than with quantity. Dr. Friend has charge of the health of the boys at Christ's Hospital; perhaps the members of this and similar closed communities may be regarded as adequate critics of palatability and other human aspects of diet. The nutritional value of fresh fruit and vegetables varies considerably, and but little is known about factors affecting variation. Emphasis is placed upon the necessity for co-ordinating human and plant nutrition. The best way of ensuring qualitative adequacy of protective vegetable foods is to begin with their cultivation. Soil conditions must be suitable for the production of sufficient amounts of vitamins and the minor essential elements necessary for human nutrition. Such high-grade vegetables naturally cost more to grow, and one of the problems of the future will be to convince those who hold the economic control of diet of the value of such improved produce.

The Tobacco Problem

IN an address on this subject before the Southampton Medical Society on October 6, Dr. J. D. Rolleston maintained that the tobacco habit is quite as much a concern of public health as that of acute infectious disease, a view which appears to be gaining ground in Germany, where many members of the public health service are of opinion that the harm done by nicotine is as great as that caused by alcohol. In Great Britain, however, apart from the Society for the Study of Inebriety and Drug Addiction, there has been little discussion in scientific meetings of the tobacco problem, like until recently any aspects of the sexual question. In a survey of the action of tobacco on the various systems of the body, Dr. Rolleston remarked that though in most cases little harm is likely to ensue from a mild degree of smoking, some smokers, even those of long standing, are liable to develop toxic symptoms after only a small amount of tobacco, while a considerable proportion of all tobacco consumers smoke to excess. Other subjects discussed in the address were the incidence of smoking in different countries, the relation of tobacco to cancer of the upper respiratory and alimentary tracts, tobacco in training, smoking in hospital wards, the occurrence of extensive fires due to smokers' carelessness and the formation in 1926 of the National Society of Non-Smokers.

A Philosophical Overhaul

WE have received the first chapter of a book entitled *A "Philosophical Overhaul"* by Oscar Ljungström, printed in English by H. Ohlsson of Lund. It is a well-written philosophical disquisition on such subjects as force, gravitation, chance, free will, causation, time, etc. It is most readable and forces one to think. The author begins "A philo-

sopher is a doubtful man, and he puts all kinds of unnecessary questions. Not like Socrates in the forenoon, to the citizens of his own town. For if he did that nowadays they would probably turn him out with the American injunction: 'If you have nothing to do, don't do it here'. So it is safest for him to keep his doubts within his own soul, murmuring some answers to himself." The questioner has contracted the habit of writing books and so he gives the first chapter of a proposed book. He suggests that gravitation may be explained by cosmic radiation and that time cannot be measured at all. He has the merit of not being dogmatic and his suggestions are interesting and put forward modestly.

A Business Man's Library

A SELECTED list of books under the heading "A Business Man's Library" compiled by the Management Library has been issued by the National Book Council, 3 Henrietta Street, Covent Garden, London, W.C.2, from which copies may be obtained. The list covers purchasing, factory management, personnel and industrial psychology, sales management, market research, advertising, transport, general management, accountancy and statistics, commercial law, industrial biography and industrial history. While not exhaustive, it includes most of the significant recent additions to the literature of this field and is a useful adjunct to the more comprehensive "Business Man's Guide to Management", the fifth edition of which has just been published by the Management Library (23 Bloomsbury Square, W.C.1). In addition to the classified lists of books, with brief descriptive notes on their scope or contents, the latter contains a subject index, a publisher index and an author index as well as suggested courses of reading. Reference to the main divisions, general management, accounting, production, distribution, company secretary, psychology, industrial economics, in which the books are listed is facilitated by use of different coloured paper for these divisions.

Library of the American Philosophical Society

THE report on the library of the American Philosophical Society for 1936 includes details of the more important additions (Philadelphia: American Philosophical Society). Among the new exchanges of publications established during the year is one with the library of Armstrong College, Newcastle-on-Tyne. At the end of the year the Library contained 80,918 volumes, 48,468 pamphlets and 5,374 maps. The Library does not attempt to develop all fields of learning, but only those in which it is already strong or has historic interest. No expansion in modern books on medicine is contemplated owing to the existence in Philadelphia of a very important medical library, but fields in which development is intended include exploration; botany, scientific and applied; the history of science; the inter-relation of the sciences; the co-operation of learned societies and institutions. Further contributions have been made to the promotion of the Union Catalogue of Philadelphia, and the report includes a summary list of archival materials in the possession of the Library.

the most important of which is the collection of Franklin manuscripts. Much work has been carried out in preparation for the issue of a descriptive catalogue of those manuscript collections.

Smithsonian Publications

A CLASSIFIED list of Smithsonian Publications, available for distribution, August 10, 1937, compiled by Helen Monro, has been published by the Smithsonian Institution, Washington (Publication 3394). The papers are supplied only as an aid to researches or studies in which the applicant is specially interested, and accordingly applicants are required to state the grounds for their request. Except where prices are given in the list, the papers are distributed gratis. The serial publications of the Smithsonian Institution are of three types: Smithsonian Contributions to Knowledge; Smithsonian Collections; Smithsonian Annual Reports. The reports are distributed gratuitously to libraries and individuals throughout the world, but very few are now available at the Institution. The papers issued in the Contributions to Knowledge and Miscellaneous Collections are not public documents but are printed in limited editions and distributed without charge to public libraries, educational institutions and learned societies. They are supplied to other institutions and to individuals at the prices indicated.

Calendar of Chemistry

AN interesting list of names and dates has been drawn up by E. H. Huntress with the title: "Daily Chemical Anniversaries as a Teaching Tool", published in the *Journal of Chemical Education* (14, 328; 1937; obtainable in reprint form at a small charge). In this, each day of the year is assigned to some names of investigators distinguished for their contributions to chemistry and related sciences, who were born on that day in a year specified. The date of death is also given when the person is no longer living. In this way a valuable historical document has been produced, and it is clear from the brief introduction by the author that he has taken a great deal of trouble in collecting his material from reliable sources and in converting the dates based on different calendars to the Gregorian basis. He suggests that the list can be made use of in teaching, and it certainly offers interesting possibilities in this direction.

Game Research

APART from a few special investigations, such as that on grouse disease, little persistent attempt has been made to study the diseases of game or methods of controlling disease or increasing the health and productivity of game. The opening a few years ago of a game research estate at Knebworth by Imperial Chemical Industries Ltd. was therefore a movement of scientific as well as of sporting interest, and now a second centre has been set up at Jealott's Hill, Warfield, Berkshire, for the study of problems relating to intensive rearing and the incidence of disease. From these stations appear occasional short pamphlets dealing with the progress of research or

summarizing present knowledge regarding specific diseases. Advisory Leaflet No. 12 (June 1937) deals with a few diseases of game most commonly encountered on rearing-fields and amongst wild stock, and offers some suggestions for simple treatment such as a keeper could apply. The diseases referred to are gapes, coccidiosis, cramp, pneumonia, 'sore mouth', and strongylosis or 'partridge disease'.

Partridge Mortality

THE question of "Partridge Stocks and Mortalities" is discussed in I.C.I. Game Researches, Advisory Leaflet 13, June 1937. The pamphlet is based upon information gathered from a large number of partridge manors throughout Great Britain and analysed by A. D. Middleton, of the Bureau of Animal Population. The matters discussed include losses of nests, fertility of eggs, mortality in young partridges, stock estimates, winter wastage, mortality and its reduction. The pamphlet is simply written and should be a useful guide to the shooting man and his keeper—to whom the original papers are not likely to be available—as to what may be expected amongst a normal stock of wild partridges.

Bibliography of Seismology

THE recent quarterly part of the "Bibliography of Seismology", edited by Mr. Ernest A. Hodgson, concludes the record for the year 1936 (*Pub. Dominion Observatory, Ottawa*, 12, 1936-37). The value of the work will be evident from the fact that the number of entries for the year is 429. To a great extent, the practice of adding notes on, or abstracts of, the memoirs is abandoned. On the other hand, the useful plan of giving references to notes or articles in various scientific journals—such as *NATURE*, *Science*, etc., and the *Proceedings* of such bodies as the Academy of Sciences of the U.S.S.R., the Geodetic Survey of India and the Society of Petroleum Geophysicists—is extended. The countries in which earthquakes are studied are now so well represented on the list of contributors that few, if any, memoirs of importance can escape notice. The last number contains a useful subject-index under more than fifty headings.

An Active Sunspot

A LARGE and active group of sunspots, visible to the naked eye, is in transit across the sun's disk (September 28–October 11) in latitude 10° N. The date of central meridian passage was October 4.6. The following measures of area made at Greenwich and expressed in millionths of the sun's hemisphere illustrate the rapid growth of the group from September 28, when it was seen coming into view at the sun's east limb:

Sept. 28.4d	Area 450
" 29.3	" 1100
" 30.4	" 1700
Oct. 1.8	" 2100
" 4.4	" 8100

By October 1, a number of separate nuclei had developed into one very long complex spot.

(Continued on p. 641)

NATURE

SUPPLEMENT

No. 3545

SATURDAY, OCTOBER 9, 1937

Vol. 140

Scientific Endeavour and Inferiority Complex

Recollections of My Life

By Santiago Ramón y Cajal. Translated by Prof. E. Horne Craigie, with the assistance of Prof. Juan Cano. (*Memoirs of the American Philosophical Society*, Vol. 8, Parts 1 and 2.) Part 1. Pp. xi + 272 + 13 plates. Part 2. Pp. ii + 273 + 638 + plates 14–21. (Philadelphia: American Philosophical Society; London: Oxford University Press, 1937.) 22s. 6d. net.

IT is a pleasure to greet this work in an English dress. The Spanish original appeared in Madrid in 1923. A personal document, at once historical and self-revealing, it went through three editions before its author's death in 1934. For it to be accessible to a larger audience has been a desideratum for some years.

Among autobiographies of scientific men this seems likely to occupy permanently an outstanding place. It presents features, and attaches to circumstances, of exceptional interest. It comes from the pen of one who was not only a great master in his branch of science but was also a personality of rare attraction. It deals with the story of a time pregnant with change and revulsion from old ways in the writer's own country. It tells this story from its particular angle the more effectively by reason of a certain detachment from the political field, a detachment based on loftiness of view rather than on any lack of passion for his country's cause.

The microscopist on the whole is, we may think, at some disadvantage for facts in his career which shall enlist general or public interest. He has not the romance of being armed with a gigantic instrument exploring spaces and systems which by their mere enumeration leave thought staggered. His life is perforce a sedentary one with little opening for adventure. Moreover, even with the microscope, Cajal's scope of observation lay in

a field not containing such exciting things as the seeds of new diseases or the specks identified as carriers of particulate heredity. It was on no such grounds as those that these "Recollections of My Life" have justified their writing. As to Cajal's scientific work, it is not always the discoverer himself who can best set forth to a lay world the broad meaning of what he has discovered. Nor do we think Cajal excels in that particular respect. Yet the book succeeds in presenting his scientific work clearly and well, though not with much gift of popular exposition. His achievement was not of a kind made easily the subject of spectacular appeal. It introduced, however, a new conception of the structure of the nervous system in its entirety and throughout.

It is probably true to say that no single observer ever yet so enlarged our knowledge of the construction of that system. His fresh conception of the structure carried with it unusually unequivocal inferences regarding certain fundamental features of its working. For physiologist and pathologist, the nervous system after Cajal's discoveries and interpretation was something so much clearer and so other than it had been as to be a system almost new, and one immensely more intelligible. That was a revolution dramatic enough to those observers technically facing the problem. But to those not so specially acquainted with it, its very technicality stood in the way of the investment of it with great general interest. The work before us has therefore, we think prudently, curtailed some of the scientific summaries and discussion, and dispenses with some of the scientific illustrations. Those parts of the work which are its truer sources of appeal and value are thus assisted rather than impaired.

One of the permanent sources of appeal in this unrestrained autobiography—for such it is—is its

frequent half-naïve, but never gratingly egotistical, resort to and exposition of its author's own views on human life and character in general, his own instance being commonly their text. These thoughts are often strikingly unsophisticated, the very reference to them somewhat of a departure from convention. At times this, like magic, turns a slight circumstance into a memorable and arresting passage for the reader. It is surely a prerogative of the Latin genius little permitted or possible to what goes by the name of Anglo-Saxon. It must have presented especial difficulty for this translation of the book. Prof. Horne Craigie has, we think, dealt with it in the best way possible. "So much of the personality of an author is contained in his very diction and phraseology, that it was felt best to risk sacrificing to some extent the values of literary English in order to try to give as precise rendition as possible of each word or phrase of the original". The reader finds that this has been done with exemplary care. In result a trace of exotic character tends to attach to the text in many places, and to our thinking harmonizes with it, because it seems in keeping with something exotic to us in the author's sentiment.

One interest of the book is, and will probably for a long time increasingly be, the writer's picture of Spain, the position science and scientific medicine held there, and their social and quasi-political contacts in Spain during the writer's long career. Light is shed on, for one thing, an inefficiency of educational organization for science such as, whatever be the issue of the present conflict in Spain, can, so long as this book speaks, never return. The book is a self-portrayal of a heroic figure striving to regenerate his country's science and, as regards science, his country's faith in itself. It is a portrayal undertaken without vanity, and in its way free from self-consciousness. It raises before us a figure which might well serve as a symbol for a future Spain cultivating scientific achievement. We get a picture of the devoted effort of a few to re-establish in their country the cult of scientific knowledge for its own sake. The struggle depicted was against not so much any organized opposition from creed or class as against apathy under a starved educational system. Further, the national conscience had come ruefully to consent to believe that in natural science Spain was no longer to be taken seriously. An inferiority complex in respect of science sapped the nation's strength and initiative. Cajal's own contributions to research called forth from his university colleagues the remark "who is our Cajal to judge of foreign scientists?" "So deep in the vitals of our race had taken root the conviction of our sad and utter incapacity for the cultivation of Science."

Another stumbling-block for Spain, as her great master here points out, was her own language. It invests with a certain pathos some valedictory words he addressed to the young scientific Spain he had created. "One of the urgent tasks our young investigators will have is the translation into English, French or German of the essential facts discovered in our country." He had in 1897 at no small pecuniary sacrifice started a Spanish quarterly of microscopy. This with the opening of the new century became the famous *Trabajos*. But after a quarter of a century's trial he felt forced to change the title into French and to "publish the work of our laboratory in French or English". His experience was that otherwise it did not reach the scientific world; "a bitter reflection," he remarks.

Cajal had consented to be Minister of Education under a prospective term of one of the Liberal Governments. Partly at his own later request that did not come to pass. But the volume is full of reflections upon education in general and the public organization of education in Spain in particular. It is rich in reminiscence illustrating the system as it existed; he watched it in school, college and university. He lived through a period which, largely by his own example and exertion, was in some respects one of great transition. For those historians to whom the phases of history of most interest are the phases of transition, Cajal's volume provides a valuable original source. As a young student he heard vitalistic doctrines taught direct from Bordeu and the Montpellier School of the eighteenth century. Some ten years later he was facing cholera with pure cultures of the 'bacillus' and an oil-immersion lens; and he lived to find himself in a palatial laboratory abreast of the latest in the world in respect of the particular study he had made his own.

Bits of the "Recollections" were rendered into English some years ago by the accomplished medical historian Fielding Garrison, now passed away. He recognized a vein of poetry in some of Cajal's writings. It is present in this book, and with it a vein of melancholy—without that bitterness which stings in some of the aphorisms of the "Charlas de Café"—also in part at least translated by Garrison. An instance of the melancholy—and the poetical—is a passage in the last chapter of these "Recollections". Its subject is the scientific master whom old age is gripping—in fact himself at the time of his writing it. Unconsciously it challenges, by contrast, Browning's picture of Linacre in "A Grammarian's Funeral". It says, too, what Mr. Aldous Huxley, in the memorial lecture on his grandfather, said of the fate of scientific writing—but says it with a wistfulness of regret. "It is certain and even desirable

that in the course of time my insignificant personality will be forgotten; with it will doubtless perish many of my ideas. In spite of all the blandishments of self-love, the facts associated at first with the name of a particular man end by being anonymous, lost for ever in the ocean of Universal Science. The monograph impregnated with individual human quality becomes incorporated, stripped of sentiments, in the abstract doctrine of the general treatise. To the hot sun of actuality will succeed the cold beams

of the history of learning." We may express this in short by saying that, as Aristotle thought of the soul, a scientific writing has no personal immortality. Yet this book will, we fancy, long have its place on the library's 'international shelf'.

Prof. Horne Craigie is to be congratulated on his work. The volume is well produced. There are a few misprints, for example, on pp. 303, 327 and 531. The book meets a distinct need.

C. S. S.

Primitive Art and Artists

The Savage Hits Back:

or The White Man through Native Eyes. By Prof. Julius E. Lips. Translated from the German by Vincent Benson. Pp. xxxi + 254. (London: Lovat Dickson, Ltd., 1937.) 21s. net.

AFTER this book had been written and was passing through the press, Prof. Julius E. Lips, formerly director of the Rautenstrauch-Joest Museum of Cologne, was moved to tell his readers in a foreword the circumstances of its production. Although not a Jew, his championship of freedom of thought and research brought him into conflict with the authorities and cost him his appointment. When deprived of all opportunity to continue his work and summoned to deliver up the material, which he had collected laboriously for the purpose of investigating this particular manifestation of primitive art, on the ground that it was subversive of the Nazi doctrine of Aryan supremacy—it certainly does not flatter the white man—he left his country to take refuge in Paris and later in America.

This prelude may seem irrelevant to the purpose of a study of a form of art; but it is a story which is fittingly told here. It literally shocks us into an appreciation of the fact that such masterpieces of expression and critical characterization as are shown could be produced only in an atmosphere of emotional and intellectual freedom removed *toto caelo* from the suspicions and repressions of a totalitarian regime. The advantage lies entirely with the savage.

Prof. Lips had brought together, classified, and analysed a large number of examples of primitive art in which the artist embodied his impressions of the white men with whom he has come into contact, and also of some, though indeed not many, of the white women, as well as his conception of his distant rulers in Europe. Of these a selection is figured and discussed in this volume. Most of them, though not all, are sculptures in

wood, ivory and other material. They are drawn from a wide field—Africa, Australia, Melanesia and New Guinea, the Eskimo and the Indian of the North-West Coast and South America. In time they range from the sixteenth century bronze and ivory figures of Benin art down to the present age of the motor-car. Some of the best belong to the nineteenth century. Generally, the art of the higher cultures, such as India, Japan and China, has been omitted from consideration, although some work of the Chinese has been included for purposes of comparison—a severe test, from which the primitive emerges not without credit.

When they are considered without reference to the author's purpose, these examples of primitive art are seen to attain a high standard. So far as technique and execution are concerned, they serve to illustrate the author's brief but excellent dissertation on the principles and conditions of primitive art. This dissertation, however, is more or less by way of necessary introduction to the main theme. Of the abilities of the primitive artist in his representation of that strange and in many ways mysterious being, the white man, the most striking characteristic brought out in the examples shown here is that only rarely, if at all, has there been any failure to catch and express the national particularities of the model. Englishman, Frenchman, German, Russian, whatever he may be, it is impossible to mistake what the artist intended to represent—and the likeness is more than superficial, it is a portrayal of the spirit. Here, as always, African art excels, perhaps most because of its deep-seated humour and its genius for exaggerated characterization, amounting at times to caricature. In contrast, Prof. Lips maintains that before Gauguin no European artist, with one exception, had succeeded in representing the primitive; while in travel books before the photograph, representations of natives were no more than Europeans sometimes, but not always,

decked out in the appropriate native costume and ornament. This sweeping statement is something of an exaggeration; but it has much to support it. In these examples of African art, however, there can be no question; and English officer, French officer, native soldiery, missionary, trader, and even the English female tourist are touched off to the life. Africa, however, has no monopoly. Russian figures from the North-West Coast are no less successful, and the masks of massacred sailors or traders from New Ireland are distressingly true to fact.

Prof. Lips, in discussing the principles which govern the approach to the study of primitive art, emphasizes the fact that such an art can exist only as a manifestation of, and in relation to, a specific culture. Incidentally, in characterizing a certain school of modern sculpture as purely African, he provides both a condemnation and a refutation of aesthetic theories which ignore the anthropological point of view. When, however, he goes on to deplore the inevitable disappearance of primitive art, as do other writers on African

art for example, he is guilty, may it be said with all due respect, of a certain confusion of thought. His material must surely demonstrate this. The primitive cultures which produced it had already undergone modification by European contacts. The art, in consequence, had suffered some change, but it had neither deteriorated nor perished. Provided that it can be ensured that change in culture is organic, as for example is the aim of 'indirect rule', and not disruptive, but follows lines of development inherent in native custom and institutions, there is no reason why the capacity for artistic expression should not develop likewise, provided it is not disturbed and crippled by the introduction of alien European ideas, principles and technique. This, at least, would seem to be the lesson of the experimental introduction of native craftsmen as teachers at Achimota.

Finally, it may be said that this is a book which no student of social anthropology can afford to neglect. Apart from the light it throws on primitive art and artists, it is an illuminating study of the ways of thought of the primitive mind.

The Distribution of Animals

(1) Ecological Animal Geography

An authorized, rewritten edition based on "Tiergeographie auf ökologischer Grundlage" by Prof. Richard Hesse. Prepared by W. C. Allee and Karl P. Schmidt. Pp. xiv + 597. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 30s. net.

(2) Animal Communities in Temperate America: as illustrated in the Chicago Region—a Study in Animal Ecology. By Victor E. Shelford. (Geographic Society of Chicago, Bulletin No. 5.) Second edition. Pp. xiii + 368. (Chicago: University of Chicago Press; London: Cambridge University Press, 1937.) 13s. 6d. net.

DURING the present century, the study of the distribution of animals has entered upon a new phase, marked by a more intense examination of the relationship between animals and their environment, and a desire to bring to the understanding of distribution a physiological point of view applied to communities as well as to individual species and systematic groups. As regards land animals the older works, of Murray, Wallace, Heilprin, Trouessart, Beddard, Lydekker, Sclater and others, were based largely upon the knowledge of mammals and birds, and these warm-blooded animals were less obviously subject to several climatic factors which regulate the distribution of less specialized animals; whereas, as regards

marine organisms, from the time of Edward Forbes, the tendency had been to accumulate data of distribution with reference to 'zones' or other generalized areas.

The development of ecology has given a new complexion to the understanding of distribution, and although in this respect the zoologist has lagged behind the botanist, the works noticed here have consolidated the position and placed the zoologist in line for further advances.

(1) Prof. Richard Hesse's "Tiergeographie" set a new standard, with its appeal to modern methods and its weighty accumulation of examples widely drawn from zoological research papers. There has been no English work quite like it, although the posthumous volume of Dr. Marion I. Newbigin, "Plant and Animal Geography" (1936), discussed ably and in a rather less minute way some of its main topics. Since the publication of the "Tiergeographie" in 1924, however, much has been done, and the translators and joint-authors, realizing that a transcript would no longer meet the needs, have with Prof. Hesse's concurrence placed their own stamp very thoroughly upon the work. They have used their own experience and reading to revise and add, have deleted material with which they did not agree—for example, Lamarckian interpretations stuck in their gorge and were rejected—and they have increased the emphasis upon the influence of marked climatic

variations during the world's history and upon the stability of the present ocean basins. The chapter on the influence of man upon animals has been rewritten, mainly from an American point of view, and the text has been made more readable by the weeding out of Hesse's plethora of scientific names and the simplification of the scientific references. The result is a first-rate work, containing much widely gathered information, and suggesting many problems for the ecologist.

Since the original book was not reviewed in NATURE, its scope may be indicated. The greater part, in three sections comprising nineteen chapters, discusses the actual distribution of animals, in the sea (138 pp.), in inland waters (89 pp.), and on the land (180 pp.). In each case the discussion leads off with an account of the environmental factors and of their relation to animal life, and this is followed by more detailed accounts of the various communities and their structural and physiological relations to the natural conditions in which they live. Preceding these descriptive sections is a valuable introductory section of nine chapters (149 pp.) setting out the general problems and relations of ecological animal geography.

The difficulty about biological generalizations is that exceptions so often threaten to break the rule; in other words, the factors are so complicated that clear cases seldom occur. Here the familiar zoogeographical regions of the earth's surface are condemned as abstractions, because transition areas transgress their supposed objective boundaries; but the positive conclusion is the more helpful, namely, that "the faunal regions are divisions of the earth's surface in which the animal life bears a somewhat uniform aspect, and differs from that of the neighbouring regions in consequence of independent evolution during longer or shorter periods of isolation". When the authors, in support of Bergmann's rule that when the same species inhabits different climates the individuals tend to attain the greatest size in the coolest regions, cite (amongst others) the case of the red-deer as increasing in size towards the north-east of Europe and decreasing towards the south-west, they seem to lean upon a weak reed, for the Norwegian specimens are less than the Swedish, and both are inferior to the deer of Germany and the Carpathians; perhaps the factor of food upsets the rule. Also, how are we to account for the fact that the distinctive forms of the sea-girt St. Kilda (oceanic climate), whether they be field-mice or house-mice or wrens, are larger than their fellows on the Scottish mainland? It is an interesting thesis, supported by many examples and accounted for in various ways, that the extent of a region is reflected directly in the numbers of its species and even in their size.

In regard to the major facts of historical geography, the authors dismiss Wegener's theory of continental drift in a sentence; but since the 1928 symposium which they follow, geologists have been weakening in their opposition, and the remarkable parallels drawn by du Toit between the geological formations of South America and South Africa suggest that zoologists should for the present keep an open mind.

In the bibliographies the translators have included many important works published since 1924, but admitting that rigid selection was necessary, reference might usefully have been made to C. B. Williams's "Migration of Butterflies" (1930) in connexion with the movements of insects, to Taussig's important "Ökologischen Haustiergeographie" (1932), and in connexion with inland waters to Murray and Pullar's six-volume "Bathymetrical Survey of Scottish Fresh-water Lochs" (1910), and Hora's accounts of the adaptations of animals in rapidly running streams.

The book is well printed, is illustrated by instructive and modern text-figures (although there is a wretched photograph of the gannets on the Bass Rock), and is very free from slips ("save" for have, p. 117, l. 31; "Agric." for Avic., p. 418 ref. 10; and the misleading "Baltic starfish" given as the English name for the four-bearded rockling).

Most of these points are matters of opinion, but there can be no two opinions about the value of the book itself.

(2) Shelford's "Animal Communities" has been for so many years an indispensable guide in the teaching of ecology in Great Britain that its merits do not require to be stressed. The second edition is an impression of the first, unchanged except for the correction of typographical and clerical errors, the modification of community nomenclature, and the addition of a short bibliographical appendix. But the advances of animal ecology since the original work appeared in 1912 make it odd to read the complaint that zoology has furnished geography only with data almost exclusively concerning the taxonomy and morphology of animals (p. 318); Hesse (not mentioned in the bibliography) and his cloud of witnesses are the answer. In the first chapter (where "Thompson" (p. 6) should be Thomson), the section on "the economic importance of animals" contains no reference to domestication.

However, the body of this pioneer work, a descriptive account of typical habitats and their communities, with occasional suggestions of the changes which both may undergo in parallel, retains its original value as an introduction to the modern method of field natural history.

JAMES RITCHIE

Communal Life Among Termites

The Soul of the White Ant

By Eugène N. Marais. With a Biographical Note by his Son and translated by Winifred de Kok. Pp. xv + 184 + 8 plates. (London: Methuen and Co., Ltd., 1937.) 7s. 6d. net.

THIS book is of considerable interest; it contains a number of original observations and there are some good plates and text figures. The original was written in Afrikaans and the translation is by Winifred de Kok.

The translator, in her preface, writes: "His years of unceasing work on the veld led Eugène Marais to formulate his theory that the individual nest of the termites is similar in every respect to the organism of an animal, workers and soldiers resembling red and white blood corpuscles, the fungus gardens the digestive organs, the queen functioning as the brain, and the sexual flight being in every respect analogous to the escape of spermatozoa and ova.

"About six years after these articles appeared (his original papers) Maurice Maeterlinck published his book 'The Life of the White Ant', in which he describes this organic unity of the termitary and compares it with the human body. This theory aroused great interest at the time and was generally accepted as an original one formulated by Maeterlinck."

Marais further classes the workers as the mouth and teeth and the soldiers as the functional equivalent of the medulla oblongata; the fungus gardens as the stomach and liver, and the termitary itself as not a heap of dead earth, but as a separate animal at a certain stage of development—a composite animal in exactly the same way that man is a separate composite animal, only without the power of locomotion. By the operation of natural selection the final result will be a termitary which moves slowly over the veld! We fear we have not sufficient imagination to conjure up such a miracle. Such a theory would naturally appeal to the poetical mind of Maeterlinck; but he should at least have given Marais the credit for it.

It appears to us that the author in his endeavour to prove his theory over-reached himself, and probably thereby lost sight of a number of equally interesting facts and problems. We have seen it stated that if his facts are beyond question his theory is quite unanswerable. We do not agree with this statement; but at the same time we propose to show that in many instances what he says is incorrect.

The theory itself is only a poetical invention and gets one nowhere. One might equally well compare the termitary to the heavenly bodies, the queen being the sun, etc., and use similar arguments to try to prove it. The statement that the king and queen are ordinary four-winged *neuropterous* insects is contrary to what is known on the subject. Termites are now considered to be descended from a common ancestor to that of cockroaches, and possess some characters similar to those insects.

The queen is said by Marais to have the power of producing three different forms of insects: the queen, the worker, the soldier. As a matter of fact she can produce, as shown by Wheeler, sixteen different kinds of individuals, as follows: first-form males and females (true kings and queens); second-form males and females; third-form males and females; large male and female workers; small male and female workers; large male and female soldiers; medium-sized male and female soldiers; small male and female soldiers.

It is probable that not all these occur at once in one colony, but five or six are often to be met with in a single colony.

It is stated that all direct activity ceases in the termitary immediately the queen is destroyed, and there is an end to the community as such.

This may be the case in a small new termitary, but certainly not in a large old one. The second- and third-form adults are complementary or substitutable kings and queens, and can be used if, or when, the true queen (or king) dies. The second form have wing pads or incipient wings and perfectly formed reproductive organs, though smaller than in the first form, and the third form are entirely wingless, but possess mature reproductive organs which are smaller than in the second form.

The author says of the true kings and queens that one moment the insect is flying, a moment later the wings are detached, yet one finds no evidence of a lesion. Wheeler points out that the wings of the first-form adults break off at pre-formed basal sutures, and old individuals of this caste can always be recognized by the truncated wing-stubs. Marais also mentions wing-buds being sometimes present, but attributes this to atavism.

Many other instances might be brought forward, but the space at our disposal will not permit. It must be remembered that the habits of different species of termites (as with ants) differ, and the author was only observing one species.

HORACE DONISTHORPE.

Amenities of the Countryside

(1) England under Trust :

the Principal Properties held by the National Trust in England and Wales. Described and illustrated by J. Dixon-Scott. Pp. xx + 339 + 62 plates. (London : Alexander Maclehose and Co., 1937.) 7s. 6d. net.

(2) Britain and the Beast

By J. M. Keynes, H. J. Massingham, Sheila Kaye-Smith, E. M. Forster, W. A. Eden, C. E. M. Joad, John Moore, Clough Williams-Ellis, Geoffrey M. Bompfrey, R. G. Stapledon, A. G. Street, Patrick Abercrombie, Thomas Sharp, G. C. Hines, Howard Marshall, Lord Horder of Ashford, G. M. Trevelyan, John Gloag, Sir William Beach Thomas, S. P. B. Mais, R. M. Lockley, Kenneth Spence, Edmund Vale, George Scott-Moncrieff, Lord Howard of Penrith, Aileen Tatton Brown. Pp. xx + 332 + 41 plates. (London : J. M. Dent and Sons, Ltd., 1937.) 10s. 6d. net.

THE almost simultaneous publication of these two books marks an important stage in the increasing consciousness of Englishmen that they have in their countryside and their older buildings a historic heritage of incalculable value which is in danger of destruction and ought to be made secure for the enjoyment and education of their descendants. One of them is a pictorial and descriptive account of the principal properties held by the National Trust and is thus primarily a record of achievement : the other contains the views of twenty-six eminent persons on various aspects of the problem, some being content to describe, and generally to deplore, the present situation, while others put forward suggestions more or less comprehensive and more or less practical, which they would like to see adopted in a future policy.

(1) "England under Trust" contains accounts of more than fifty properties now held by the National Trust. They range geographically from Cornwall to the Roman Wall in Northumberland, and from Kent to the Lake District : in area they may be as small as Coleridge's Cottage at Nether Stowey, or as extensive as the seven thousand acres of the Holnicote Estate in Somerset. They include properties of every description—ranges of cliffs in Cornwall, an ancient hostelry in Southwark, great stretches of moorland and fell in the Lake District, historic houses like Bodiam, Tattersall, or Montacute, a complete village in Buckinghamshire, and six hundred acres of Cambridgeshire Fens.

A most encouraging feature of the record is that the Trust seems to be accumulating properties

at a rate which is rapidly increasing : the number of acquisitions here illustrated which have come into its hands since 1930 is surprisingly large. It is also interesting to note that while Cornwall and the south-west generally seem to vie with the Lake District as the areas in which the Trust has been most successful in its aims, Norfolk, Yorkshire, and the north-east as a whole seem to be still almost untouched by its activities. Another fact which emerges is that the Trust now holds a considerable number of the few remaining ancient village clergy-houses ; of these, the Alfriston parsonage is probably the best known, but the church houses of Widdecombe, Muchelney, and West Wycombe are all delightful buildings.

The most valuable feature of the book lies in the magnificent series of photographs by Mr. J. Dixon-Scott : every property described is illustrated by at least one of these, and both in composition and reproduction they could scarcely be bettered. It is a pity that the descriptive notes are not up to the standard of the illustrations : they are pleasantly written on the whole, but elementary grammatical errors can be found by the curious on pp. 81, 113, 147, 189, 197, 227, and 228 ; and it is somewhat disconcerting to find elementary historical errors also in a book the scholarship of which Prof. G. M. Trevelyan has specially commended in his foreword. The Antonine Wall, for example, was not built by Agricola (p. 24) : nor did Boudicca sack Lincoln and York (p. 187), though she did sack London, which according to Mr. Dixon-Scott escaped her : nor did the Black Prince live in the fifteenth century (p. 208). In the account of Tintagel there is no mention of Mr. Radford's recent and very important excavations, which have illuminated its history far better than the shadowy Arthurian connexions, here detailed without a suggestion of doubt on their historicity. One would have hoped that a book issued under the auspices of what is after all the National Trust for Places of Historic Interest would have paid more regard to the claims of historic accuracy.

(2) "Britain and the Beast" is a thoroughly depressing book, partly because it directs attention to depressing facts with which most people are familiar (although apparently not familiar enough) and partly because its twenty-six eminent authors, in spite of ten introductory pats-on-the-back from ten even more eminent persons, have nothing approaching a common policy for improving matters. Indeed the editor, Mr. Clough Williams-Ellis, has probably been wise to let each member

of his curious team have his own say in his own way, permitting no argument with his neighbours, for if anything like a symposium, in the proper sense of that abused word, had been attempted, it would probably have developed fairly quickly into a 'rough house'. Thus C. E. M. Joad's opening assumption that the primary purpose of the countryside is to provide space for townsmen to play in, is met by A. G. Street, who asserts with some asperity that it is meant for countrymen to work in. H. J. Massingham, in a survey of English agrarian history which is little better than a caricature, believes that the big landowners have ruined the rural scene; W. A. Eden, on the other hand, thinks that they are responsible for most of its loveliness. G. M. Boumphrey urges that a rigid line should be drawn between town and country, while Aileen Tatton Brown apparently contemplates an England which by 1987 has become one vast garden city.

Most of the writers seem to want the establishment of national parks, but they are far from agreed either on their location or their purpose. The individual contributions are of very varying length and, one may add, of very varying merit: some of the authors have really nothing to say,

some have a great deal too much, and some again are so choleric that it is difficult to make out whether they have any coherent ideas at all. Among those which fall into none of these classes may be mentioned W. A. Eden's sensible and constructive account of the landowner's contribution; Sheila Kaye-Smith's interesting revelations on the economics of speculative building; the editor's scheme for scheduling historic houses and their owners; P. Abercrombie's practical analysis of the deficiencies of present town and country planning legislation; K. Spence's straightforward ideas on the Lake District; and Lord Howard of Penrith's excellent account of the amenity laws in Switzerland, Germany and Sweden; while Sir W. Beach Thomas's translation of "*Littera scripta manet*" (it is very hard to get rid of printed offal) deserves a cheer all to itself.

It is a great pity that the obviously excellent photographs have been ruined by running them right over the edge of the page, leaving no margin—a modern practice which has little to commend it—and by printing them on much less satisfactory paper than is used in "*England under Trust*". Altogether a depressing book; but that, after all, is presumably what its authors intended it to be.

The Growth of Modern Chemistry

A Hundred Years of Chemistry

By Prof. Alexander Findlay. (The Hundred Years Series.) Pp. 352. (London: Gerald Duckworth and Co., Ltd., 1937.) 15s. net.

TO write an account of the development of chemistry during the last hundred years is a task which might well daunt even the boldest spirit; for chemistry is a major science advancing rapidly on an ever-widening front, and the period in question begins not long after chemistry had become an exact science capable of mathematical interpretation. The infusion into the body of science of a new spirit—an achievement which, in Liebig's words, constituted the immortal glory of Lavoisier—led rapidly to the formulation of that comprehensive Atomic Theory the ramifications of which form the nervous system of the wonderful body of physical science as we know it to-day.

Prof. Findlay's task has been to take up the story of chemistry soon after the birth of Dalton's theory, and to trace these ramifications in a concise and intelligible manner. Such a task calls for many qualifications. Among them may be mentioned the sixth sense of the historian, the power

of critical discrimination and selection, the gift of terse expression, unending patience, a courage which never fails, and a determination to achieve the highest possible degree of accuracy. A perusal of Prof. Findlay's book will convince the most fastidious reader that the author has all these requisites.

Covering with swift strokes of his brush the limited canvas represented by some three hundred pages, our 'chymicall Artist' has produced a harmonious panorama of this century of chemistry, peopled by a rich array of pioneers of the science. As the picture grows beneath our gaze, we see how the molecular theory of Avogadro arose as an inevitable outcome of the atomic theory of Dalton; how the molecular theory called with an increasing insistence for the development of a conception of the linking of atoms into a molecular structure; and how, in turn, a body of seemingly irreconcilable facts led to the expansion of the two-dimensional organic molecular structure into a three-dimensional configuration, and thus to the birth of that vast sub-science of stereochemistry, which now embraces all substances. We see, further, how these successive advances

in theory were followed by an increasing command of practical technique, leading to the gradual elucidation of the constitution of natural products, to the synthesis of an enormous range of natural and artificial organic substances, and to the foundation of manifold industries based upon the new chemical knowledge.

Other strokes of this facile brush reveal how the determination of atomic weights led to the law of periodicity; how this law "first enabled us to perceive undiscovered elements at a distance which formerly was inaccessible to chemical vision"; how the discovery of co-ordinate families of elements indicated an identical origin; and how, as we reach the edge of the canvas, there developed from this and other sequences the idea of the electronic constitution of matter.

Our artist depicts also the spectacular developments of physical chemistry, bringing out such high-lights as the kinetic theory of gases, the correlation of physical properties and chemical constitution, the law of mass action, catalysis, the phase rule, the theory of solutions, the ionic theory . . . and, in another field of vision, the recognition and study of radioactivity, and the development of the modern theory of atomic constitution. Truly, "the records grow unceasingly, and each new grain of truth is packed, like radium, with whole worlds of light."

The value of this bird's-eye view of the growth of modern chemistry is enhanced by the copious and accurate documentation, in the form of unobtrusive footnotes. Some of these original sources have evidently been tracked down by Prof. Findlay at a considerable cost in time and labour, as they are not to be found in the ordinary books of reference. The specialist will appreciate this feature of the book as fully as the reader with a less detailed knowledge of chemistry will enjoy the easy flow of a narrative which is of necessity somewhat condensed.

As we should expect, Prof. Findlay does not neglect the human aspect of his subject, although even here, where he might have been excusably discursive, he tempers his enthusiasm with a wise restraint. He says enough to show the reader how often one investigator seems to rise upon the shoulders of another, and how narrow is the margin which sometimes divides success from failure in chemical research work. It may also be deduced that some of the figures in this historical gallery were born under a lucky star. Thus, Pasteur's first great discovery—which laid the foundations of stereochemistry—was dependent upon the fortunate choice of a specific salt, and its crystallization below a temperature of 27° C. But chance and some auspicious star have accounted for much in the history of science, as in the social and political history of nations.

Regrettably, many of these fortuitous circumstances have passed unrecorded. It is unlikely, for example, that anybody except the present reviewer knows that the first optical resolution of a substance containing no asymmetric atom in its molecule, to which Prof. Findlay refers (p. 78), was due, in the last analysis, to the dilatory habits of a certain laboratory boy, whose inaction at a critical moment has until now remained unwept, unhonoured and unsung in the records of chemistry. And certainly nobody else knows what Sir William Pope exclaimed—when the resolution had at last been effected—at the first sight of the change in the polarimeter field: suffice it to say here that he did not repeat the English equivalent of Biot's historic utterance at the first sight of the optical rotation produced by sodium ammonium laevo-tartrate: "Mon cher enfant, j'ai tant aimé les sciences dans ma vie que cela m'a fait battre le cœur!"

The reflective reader may well put down this book with the query, *Quo vadis?* "The ultimate components of matter," says Prof. Findlay (p. 261), "now appear to be two in number, the positively charged proton and the unit of negative electricity, the electron". . . . Proton and electron—positive and negative—sulphur and mercury—Sol and Luna—masculine and feminine—Yang and Yin—Osiris and Isis—sun-god and moon-goddess: what a curious appeal this doctrine of the Two Contraries has made to the human intelligence throughout the ages! The wheel turns full circle, and the father-god and mother-goddess of the ancient civilizations reappear in the latest conception of the atom. So, too, the tail-eating snake of ancient Egypt reappeared some two thousand years later in the "Chrysopoeia" of Cleopatra, and came once again in these latter days to whirl mockingly before the eyes of August Kekulé, whose fleeting vision of this ancient symbol of eternity gave birth in 1865 to the conception of the benzene ring—"the crowning achievement of the doctrine of the linking of carbon atoms".

Of chemical theory we may exclaim: "Plus ça change, plus c'est la même chose!" It is true that we have elaborated the alchemists' doctrine of the unity of matter and their sulphur-mercury theory of the constitution of metals; and that the modern imagination has bodied forth the proton, the electron, the positron, and the neutron (this last being the latest expression of the alchemical *Rebis*): but when we try to formulate the ultimate realities of matter we find them as elusive as that *ignis-fatuus* of alchemy, the Philosopher's Stone—the faith of Monday, Wednesday and Friday is the heresy of Tuesday, Thursday and Saturday. Is the path of scientific inquiry into the

fundamental nature of things fated to lead beyond the limits of human understanding into a four-dimensional world as unintelligible as the wild mysticisms of alchemy? Or will the Ouroboros Serpent, at the psychological moment, bring further enlightenment, in another vision, to some future seer of the sub-atomic world?

In these days, when an ever-increasing specialization threatens to produce a generation of

chemists running in blinkers, it is hard to find an all-round master of the science who is able to see it steadily and see it whole, and to depict it in its full coherence and beauty. Prof. Findlay is such a master, and all who have the interests of chemistry at heart will be grateful to him for producing this admirable account of the growth and present state of the science.

JOHN READ.

Atomic Spectra and Atomic Structure

(1) Atomic Spectra and the Vector Model

By A. C. Candler. Vol. 1: Series Spectra. Pp. viii + 237 + 4 plates. 15s. net. Vol. 2: Complex Spectra. Pp. vi + 279 + 4 plates. 15s. net. (Cambridge: At the University Press, 1937.)

(2) Atomic Spectra and Atomic Structure

By Prof. Gerhard Herzberg. Translated with the co-operation of the Author by Prof. J. W. T. Spinks. (Prentice-Hall Physics Series.) Pp. xv + 257. (New York: Prentice-Hall, Inc.; London, Glasgow and Bombay: Blackie and Son, Ltd., 1937.) 4.25 dollars; 18s. 6d. net.

(1) MR. CANDLER'S two volumes upon atomic spectra will appeal to the spectroscopist rather than to the general reader. As the title implies, the whole work is developed on the vector model of the atom. There is a good deal to be said for a book of this nature, for the fact remains that most practical spectroscopists use the vector model in analysis and only turn to the wave mechanics solutions when vectors break down. There is, however, frequent reference to the findings of quantum mechanics, and an introductory chapter on this might well have been included. Throughout the book the historical method of approach is used, the result being an essentially empirical introduction to each branch of the subject. Both volumes contain much detailed material bearing on fundamental principles.

The first volume deals with series spectra and has a general introduction which is clearly written. A good deal of space is justifiably devoted to a very full description of the Zeeman effect, and this is followed by an excellent chapter upon atomic magnetic properties. The description of the Stark effect is rather more detailed than the accounts usually met with in a book of this nature, but this is all to the good. The chapter on the Periodic Table of the elements includes a good deal on valency and is of interest to the chemist as well as to the physicist. Extensive tables of g factors, intensities and Rydberg term values are

included, with the view, apparently, of assisting the experimenter.

In the second volume, dealing with complex spectra, there is detailed consideration of individual spectra, a very wide range being covered in order to illustrate the spectral types found in the different columns of the Periodic Table. It is obvious that the author has consulted a large number of treatises and has thoroughly digested a great number of research publications, the resulting summary being certainly effective. An unusual chapter of interest is that dealing with the line absorption spectra of solids. A good chapter on intensities in line spectra has been included, but the intensities in hyperfine structures seem to have been neglected. Throughout this volume, as in the first, the value of the Zeeman effect is correctly stressed, each point of theoretical interest being supported with a wealth of experimental detail.

The chapter on hyperfine structure is not so satisfactory as the rest of the book, containing some omissions and errors. It is stated, for example, that no absolute measurements of hyperfine structure intensities have been made, but at least four papers on this subject have appeared since 1931. The nuclear spin given for iodine on p. 204 is the earlier incorrect value, and it is questionable whether the author is justified in assuming that, in even isotopes, absence of hyperfine structure means zero spin. The hyperfine structure Zeeman effect is treated with the same clearness that characterizes the description of the ordinary Zeeman effect, and a useful summary is given of the applications of observed nuclear spin properties to the theory of nuclear structure. The interesting method of deriving information about the structure of spectral terms from the study of the depolarization of resonance radiation might have been included.

The last two chapters in the book deal with forbidden transitions and with fluorescent crystals, the latter being particularly well done. Incidentally,

it is time spectroscopists adopted uniformity in the description of forbidden transitions. Mr. Candler uses the term "quadrupole radiation" whilst Prof. Herzberg, in writing of the same thing, calls it "quadrupole radiation". Both notations are unfortunately in regular use.

There are many beautiful plates and diagrams in the work, which is essentially descriptive, easy to read and free from difficult mathematics. It ends with valuable lists of papers on the spectra of each atom and on the hyperfine structures in the spectra. The latter compilation is, I believe, the first of its kind to appear in print and will be found useful by the research worker. Considering the amount of material in the book, the errors are few and far between. It is an excellent treatise for spectroscopists and for investigators wishing to undertake spectroscopic work on line spectra.

(2) The book by Prof. Herzberg is a translation of his recent work "Atom Spektren und Atomstruktur" (Dresden, 1936). It is an introduction to atomic spectra and atomic theory, and is admirably suited to those physicists and chemists who wish to become acquainted with the elements of the subject. Beginning with the elementary Bohr theory of the hydrogen spectrum, the author goes on to show how the vector model breaks down as soon as the helium spectrum is considered, and proceeds to explain why the wave mechanics treatment is necessary. The introduction to the wave mechanics picture of the atom is particularly lucid and is deprived of the terrors usually associated with it in the mind of the student. Throughout the book the vector model and the quantum mechanical view are skilfully blended together into a unified description of atomic processes. A useful point is that certain more difficult paragraphs giving rather detailed wave mechanical explanations are printed in small type and can,

if so desired, be avoided by the reader without destroying the continuity.

The field covered by the book is very wide. The treatment of the Zeeman effect is particularly clear, a careful balance being maintained between vector theory and wave mechanics. The Stark effect is much more briefly dealt with. It is unfortunate that the important table on p. 127 exhibiting the application of the Pauli principle has such tiny lettering that the suffixes can only be read with difficulty. Perhaps too much of chapter iv is included under small type, since, surely, all should read the important details given on series limits, perturbations and *jj* coupling. The same chapter includes a brief but very clear and precise exposition of auto-ionization. Considering the scope of the book, the chapter on hyperfine structure is reasonably complete, but again one meets the unjustifiable association of zero nuclear spin with absence of fine structure in even isotopes. This remains yet to be proved, and should be qualified in a book of an introductory nature.

The last chapter will be greatly appreciated, particularly by chemists. It deals first with atomic magnetism and then devotes a good deal of space to the applications of the known facts about atomic ionization potentials, a complete table of which is given. Amongst the subjects covered in this chapter are electron affinity, collisions of the second kind and the quantum theory of valency.

The book is illustrated by excellent diagrams and by a number of very good plates. It is only on the rarest of occasions that evidences of the German original peep through the excellent translation. This book deserves to become popular and to become widely read. Students in particular will find it a very valuable introduction which will bring them right up to the most recent developments.

S. TOLANSKY.

Chemical Engineering: Position and Prospects

The Transactions of the Chemical Engineering Congress of the World Power Conference, London, June 22—June 27, 1936

Vol. 1. Pp. lxxxv+525. Vol. 2. Pp. vi+664. Vol. 3. Pp. vi+797. Vol. 4. Pp. vi+751. Vol. 5: Index. Pp. v+164. (London: Percy Lund, Humphries and Co., Ltd., 1937.) 5 vols., £12.

EIGHTY-THREE pages at the beginning of vol. 1 contain a very complete record of what took place at the first Chemical Engineering Conference of the World Power Congress, and include an account of the various functions as well as a list of the members of the Conference.

The remainder of this volume is devoted to an important subject to the chemical engineer, namely, the materials available for the construction of chemical plant. Since iron and steel still constitute the principal materials used by the engineer, the first section is devoted to this subject and the recent developments in the manufacture of ferrous alloys and their properties. In the second section of this volume are papers on the non-ferrous metals, refractory materials, stone-ware, rubber, plastics, and the use of fibrous materials, all of which are used in the formation of apparatus employed in various branches of the chemical industry.

Twenty papers, all dealing with the important subject of separation in its various aspects, such as separation without change of phase or physical state, separation with change of phase or physical state, and separation involving physical reaction, form the first part of the second volume, whilst the later portion of the volume comprises three papers relating to fine grading and the estimation of finely divided solids, and eight papers on electrolysis and the production, application and development of electricity in the chemical industry.

The contents of the third volume are divided into four sections, the first of which consists of eleven papers on destructive distillation, more especially in its relation to the gas industry, as well as the blending of coals for this purpose and the correlation between the analysis of coal and its carbonization in semi-scale and industrial plants. Waste materials and the disposal of effluents form an important problem both to the industrialist and to the individual members of any community and are discussed in four papers in the first part of the next section, whilst three other papers in the second part are concerned with the production, treatment and properties of lubricating oils.

High pressures and vacua are now being more and more extensively used in industry, so it is appropriate that seven papers on these subjects should be included in the third section of this volume, in which papers on the technology of high vacua, construction of welded pressure vessels, synthesis of organic compounds, and liquid and gaseous phase reactions under high pressure are presented.

Since the addition or removal of heat is an important feature in many chemical operations, it is not surprising that the last section of this volume is given over to this subject. In the nine papers presented, such aspects as thermal compression, condensation of vapours and mixtures of vapours and gases, and other important factors connected with the application of heat in industrial problems as well as the mechanism by which the transference of heat is actually effected, have been considered.

Vol. 4 also comprises four sections, the first of which is devoted to the education and training of a chemical engineer and contains seven papers. Considerable difference in opinion has been expressed from time to time on the question of the education and duties of the chemical engineer, so that this section should prove one of the most valuable in the volume and one which should be helpful in future conferences, as it indicates the views of the leaders in this subject in those countries where classes exist for the training of industrialists of this type.

To anyone engaged in the administration of an industrial concern such subjects as efficiency, planning and control of chemical works, prevention of accidents therein and the methods of analysing the cost of a process, which form the themes of seven papers in the second section of this volume, are of interest and importance.

Under the heading of trend of development are thirteen papers upon a variety of subjects which can be broadly classified into three groups, namely, treatment of water for both steam raising and industrial purposes; the heavy chemical industry comprising sulphuric acid manufacture, phosphatic fertilizers and the production of calcium carbide; and thirdly, papers relating to biological processes such as fermentation, fumigation and refrigeration, all of which are included in the general term of chemical industry.

In the last section of this volume and the last session of the Congress are a group of eleven papers classified under the heading of general aspects, which can be conveniently subdivided into two subsections, namely, those papers relating to fundamental research and those to applied research. Applied research comprises the development of research laboratories by large industrial organizations, the applications of the results obtained either from fundamental or applied research to the design of chemical plant, and the investigation and study of the raw materials of a country and their utility to chemical industry. At the end of each section is a report showing the main features of each paper in that section which might form the basis for discussion, and this is followed by the discussion which took place on the papers contained in that section.

Several factors have apparently influenced the grouping of the papers, of which one of the most important was the time available for presentation and discussion, which in many instances was too short for the importance of the subject under review. The different interpretations placed upon the term chemical engineer having been to some extent clarified during this Congress, should result in the papers submitted to subsequent conferences of this kind being even more germane to the subject.

Any review of this publication would be incomplete if no mention were made of a fifth volume of one hundred and sixty-four pages which has been very carefully prepared and edited, comprising both subject and name indexes.

These books should prove a very useful addition to any library dealing with their subject, since they give world-wide views on the various aspects of a large and complex problem.

One cannot conclude without expressing appreciation of the manner in which these transactions have been printed and edited.

Corrosion of Metals

Metallic Corrosion, Passivity and Protection
By Dr. Ulick R. Evans. Pp. xxiii + 720. (London : Edward Arnold and Co., 1937.) 45s. net.

THE importance of corrosion and protection of metals and alloys against corrosion especially to engineers, chemists and metallurgists needs no emphasis to-day. Wherever and whenever the commoner metals are used, corrosion may make its appearance. A significant feature of the study of corrosion is the enormous amount of investigation work that has been done during the past ten years. Dr. U. R. Evans has wisely taken the course of writing an up-to-date account of the subject as it stands at present in preference to revising his earlier book on "Corrosion of Metals", the last edition of which appeared in 1926.

The research work of Dr. Evans on corrosion is very well known not only to engineers and manufacturing chemists, to whom the new work is addressed, but also to the wider realms of science and technology of modern civilization. During the last ten busy years of corrosion-science, Dr. Evans has been the leader of a strong team of research workers at Cambridge, from which notable contributions to knowledge have emerged in a steady stream. For these reasons alone a new survey of the study of corrosion by Dr. Evans will be welcomed. Although fitting mention is made of Cambridge work, the author has not given undue prominence to it, but on the other hand has given a well-balanced account of his subject. The task of summarizing existing knowledge of corrosion is indeed an immense one, especially as the literature is so widely spread and so rapidly increasing in volume. No other author has attempted a work of these pretensions, and the new volume appears likely to occupy a unique position for many years to come.

The arrangement of the subject-matter is on a scientific basis. The author's aim is to unfold the facts leading to an understanding of the causes of the various types of corrosion, without which understanding the attempt to apply remedies may, as the author points out, be dangerous. There are fifteen chapters each dealing with a special aspect of corrosion or passivity. The treatment is somewhat unusual in that each chapter is divided into three sections, the first or *A* section of each being concerned with the scientific basis, the second or *B* section with practical problems, and the third or *C* section with quantitative treatment. This arrangement of the subject-matter should prove of value to readers who for various reasons are

more concerned with the practical aspects than the theoretical or with quantitative aspects rather than qualitative.

Separation of the aspects of corrosion studies in this way has not prevented the author from directing attention to all points of view, achieved by presentation of very interesting subject-matter in a well-sustained manner. The reader must inevitably find himself penetrating the *B* sections even though he may have intended at first to peruse the *A* sections. This is truly a good feature and bears on the larger treatment of corrosion matter, since the subject is one which does not lend itself to empiricism. To escape the ravages of corrosion it is necessary to know not merely what is the cause but also in what manner the prevailing conditions are of influence in one way or another. In matters of corrosion, scientific treatment has ploughed stubborn ground, and those concerned with any aspect of corrosion will be the better fitted to cope with their problems the closer their acquaintance with the basic principles.

The importance of surface films on metals revealed by researches of the modern age of corrosion-study demands for them a prominent position in any treatise on corrosion, and the author appropriately devotes the opening chapters to this side of the subject. Here a useful résumé of pickling methods and results of research on pickling is well placed in view of the recent advances in pickling treatment of iron and steel, for example, to leave a protective film of phosphate on the surface with benefit to the protective effect of paints. The next chapter deals with oxidation at raised temperatures, a subject of high importance in many branches of industry.

In the next five chapters, atmospheric corrosion, tarnishing, corrosion in stagnant liquids, corrosion in moving liquids, hydrogen evolution and influence of constituents of the liquid are reviewed and discussed fully. In view of the multiplicity of factors involved and the interdependence of effects, it is not a matter of surprise that in these fields of corrosion-study different conceptions arise. In this connexion the author fittingly presents a considered statement by Bengough and Wormwell summarizing their views on corrosion of metals in salt solutions, a field in which they have made extensive researches.

The next two chapters deal with the influence of intrinsic features of metals and alloys upon corrosion. From this aspect of corrosion-study notable lines of advance have been followed to fruition, and perusal of this portion of the book

leaves the reader with an impression of the great scope for further advances as further basic knowledge is gained.

A chapter is devoted to the influence of stress and strain, and here a survey of corrosion fatigue research is given. Corrosion fatigue is one of the youngest branches of corrosion-study, and the results have been, to say the least, alarming to engineers. As in other fields, however, systematic experiments and scientific treatment are yielding information of practical value.

The rest of the book is devoted to the influence of contacts and crevices, protection by metallic coatings, protection by paints and enamels and corrosion testing, with an appendix on optical measurement of film thickness.

The book is a rich mine of information on corrosion problems and will prove of value to all chemists, engineers and metallurgists. It seems doubtful whether the binding will endure the hard use that many of the copies will surely find.

H. S.

Developments in Air Navigation

Air Navigation

British Empire edition. By Lieut.-Comdr. P. V. H. Weems, U.S.N. Edited by Arthur J. Hughes and P. F. Everitt. Pp. xiii + 490. (London: McGraw-Hill Publishing Co., Ltd.; New York: McGraw-Hill Book Co., Inc., 1937.) 30s.

THIS book presents clearly and systematically the theory and application of the present methods of air navigation, which form an integral part of the duties of the long-distance or 'deep sea' aviator. In the course of preparing this edition, the author has been in touch with officials of the Admiralty, Air Ministry, Imperial Airways, Air Service Training and others.

The rapidity with which the air pilot must determine his position—if it is to be of any value—has in recent years led to an overhaul of the abridged methods of the mariner, and, indeed, to the development of a school of air navigation. The fundamentals of dead reckoning and celestial navigation are common to all branches of the work, whether on land, on sea, or in the air; it is largely to the introduction of improved and abridged tables combined with the use of specialized instruments that the present advance in speed and simplicity is due. In short, the more quickly the observer must obtain his position, the more dependent has he become on the technical and instrumental side of the work. In this connexion Commander Weems has had the co-operation of Mr. A. J. Hughes, through whose public spirit the preparation of this edition is largely due.

The air pilot cannot stop on account of sudden fog or bad weather, and is thus forced to have at all times a fairly accurate knowledge of his position. For this purpose he employs pilotage, dead reckoning, radio and celestial navigation. Over stretches of uniform country, as for the mariner in open sea, pilotage may not assist, and dead

reckoning is handicapped by unknown variations in the direction and force of the wind, a factor of far greater importance for the aviator than for the mariner. Position lines from radio bearings are limited by the proximity of transmitting stations, and celestial navigation is, of course, dependent on visibility, though here the aviator has some advantage over the mariner in that he can usually rise above the clouds, while his bubble sextant is independent of the sea horizon. It is due to the development of the bubble system of artificial horizon that the navigators of the air and sea are now able to observe with equal facility throughout the twenty-four hours to within 5' or, under favourable conditions, considerably less. Improvements in the bubble sextant are in progress, and a type that will automatically register the mean of a series of six settings is under construction. To the list of observation reduction tables is to be added the forthcoming "Hughes Tables for Sea and Air Navigation", which appear to be a decided improvement on anything of their kind yet published. For air navigation time may be further saved by the use of precomputed altitudes, of which a full description is given.

Comprehensive descriptions, liberally illustrated, of all relevant instruments in use both in Great Britain and in America are found in appropriate parts of the text. The early chapters deal with charts, maps, projections, and their application to set requirements. The section on abridged methods of celestial navigation will be of particular interest to all navigators; it is perhaps as clear an introduction to this branch of the work as has hitherto been published.

The necessary, but often curtailed, explanation of the *Nautical Almanac* is further assisted by a comparison with the new *American Nautical Almanac*. In the latter is tabulated the Greenwich hour angle of the principal heavenly bodies, and

by this means the necessity for a knowledge of right ascension, sidereal time, the first point of Aries, or the equation of time is automatically eliminated.

The section on meteorology has been contributed by Dr. Sverre Petterssen, an international authority on the air mass theory.

It is a matter of opinion whether all the examples of the methods advocated are ideally chosen, and the present writer is not impressed with the nature of the star chart in the folder. Nevertheless, the book can be recommended with confidence to the aviator, navigator, or exploratory surveyor alike.

G. C. F.

Theory and Practice of the Calculus

The Elements of Mathematical Analysis

By J. H. Michell and M. H. Belz. Vol. 1. Pp. xxiv + 516. Vol. 2. Pp. xii + 517-1087. (London: Macmillan and Co., Ltd., 1937.) 42s. net each vol.

THE authors have set themselves the task of writing a treatise on the differential and integral calculus which should be at once practical and rigorous, while assuming only the minimum of previous mathematical knowledge. The emphasis, however, is on the practical side, the book being, to quote the dust-cover, "adapted to the particular needs of students of science and engineering".

A fairly full account of the elementary theory of functions of one real variable is given, though not enough to cover the requirements of an honours degree in mathematics. Where an appeal must be made to an unproved theorem—for example, concerning differentiation of $f(x, y(x))$ —the reader's attention is directed to the fact; and, where possible, the theorem is made to appear plausible by being proved or verified in some special case. A good feature is that in several places a strict mathematical treatment is followed by a paragraph entitled "Working Notions", in which the student is shown how loose intuitive ideas suggest or recall the result.

The presentation of the theory is, in the main, well suited to the class of students for which the treatise is intended. For example, in the main body of the work the idea of the non-terminating decimal is taken as fundamental (the Cantor theory of numbers being explained in a final chapter). This introduces very naturally the method of continued decimal subdivision to prove the fundamental theorems. One might wish, however, that this important method were rather more fully explained. Continuous functions are introduced at an early stage, and the limit of a function is dealt with by means of the easily grasped idea of potential continuity. On the other hand, the "general principle of convergence" is derived from a general discussion of limit-processes, which appears to the reviewer to be too abstract

and difficult. Taylor's theorem is very well treated, losing that air of mystery which too often surrounds it. Integration is defined as the inverse of differentiation, the Riemann integral being introduced, but discussed only for a continuous integrand. Curvature, length, area and volume are dealt with rigorously but comprehensibly.

Mathematical rigour in language is usually maintained, but in one place we have "finite" for "bounded", while there seems to be a slight slip in the proof of the limit-sum integral formula. There are a few departures from standard terminology, some of which, such as the distinction between "upper barrier" and "upper bound", are good; while others, for example, "upper continuity" (for continuity on the right), seem likely to lead to confusion.

The practical side of the book is good. There are many worked examples and a large collection of problems. Maxima and minima, interpolation, Newton's method for solving an equation, and other applications of the derivative and of Taylor's theorem are thoroughly dealt with. The trigonometric, exponential and hyperbolic functions are discussed at length and used as examples of methods previously explained, while the expocyclic and epicene functions also are introduced. There is a long section on the standard forms of integrand (with recurrence formulæ), and approximate methods of integration are not neglected. Special emphasis is laid on the calculation of the uncertainty in approximations. There is a section on curves, and one on polynomial approximation by various methods. Finally, we have an introduction to differential equations, the second order equation with constant coefficients being completely discussed. It is perhaps a pity, from the practical point of view, that the authors here keep strictly to the domain of the real variable.

To sum up, the book may be recommended to all those who wish to know something of the mathematical discipline of function-theory, but whose main concern with mathematics is as a tool.

A. J. WARD.

Short Notices

Anthropology and Ethnology

A Tribal Survey of Mongalla Province

By Members of the Province Staff and Church Missionary Society. Edited by L. F. Nalder. (Published for the International Institute of African Languages and Cultures.) Pp. viii+232. (London: Oxford University Press, 1937.) 15s. net.

THIS collective work by Government and mission officials in the most southerly part of the Anglo-Egyptian Sudan may be regarded as a supplement to the studies of C. G. and B. Z. Seligman, Driberg and Evans-Pritchard. It contains useful information, particularly about several tribes for whom hitherto there has been scarcely any published material available, and bears witness to the painstaking interest of European residents of the area in the institutions of the native peoples among whom they work. A feature of note is that nearly all the data have been collected in the vernacular.

But in view of this it is to be regretted that, except for Mr. Mynors on the Moru and Mr. Arber on the Latuka, scarcely any writer has supported his generalizations by quotation of native statements or distinguished what he actually observed from what he was told. In the absence of such empirical records, statements such as "the people's ideas [on religion] are generally very vague and unco-ordinated" or "the basis of Bari society is the clan" or "the Lango women are very liable to hysteria" are of small value. Moreover, even in matters which are comparatively easy to observe, there are many gaps in the analysis which could have been filled. In the chapter on tribal structure there is no section on family life; and the meagre summary of economic life (less than four pages) deals almost solely with technical processes, without reference to methods of productive organization and exchange.

The book has much interesting comparative material, and suggests lines for future inquiry; but it illustrates also how necessary it is nowadays that enthusiasm and hard work should be backed up by systematic anthropological training.

R. F.

Anthropology:

an Introduction to Primitive Culture. By Prof. Alexander Goldenweiser. Pp. xxi+550+30 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1937.) 18s. net.

PROF. GOLDENWEISER'S "Anthropology" was undertaken originally as a revision of his "Early Civilization"; but in the process of expansion it has grown into a new book. It now falls into three parts. The first, "Animals, Man and Culture", deals with man's place in Nature, and his relationship, physical and psychic, to the animal world, as well as his reactions in the development of culture; the second, "Primitive Life and Thought", discusses in twenty-two chapters culture traits, both material and social in

the broader sense, in the light of specific examples as exhibited in varied cultural environments; and in the third, "The Ways of Culture", certain general problems of theoretical import are considered in four chapters on culture and environment, the spread of culture, and evolution and culture. This last section will be particularly valuable to the student. It is a well-balanced and objective examination of topics into which controversial methods are apt to introduce some, however little, distortion. A chapter on "The White Man's Burden" deals with the deplorable effects on backward peoples of contact with white civilization, and describes the efforts which are being made in the United States under the legislation of 1934 to reintegrate the tribal culture of the Indian. Prof. Goldenweiser, while generally approving the object, confesses that he is not an optimist as to the result, although the Indians have shown themselves eagerly ready to take advantage of the offers made by the Government.

Biology

Atlas of the Scale Insects of North America

By G. F. Ferris. Pp. 280+104 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1937.) 40s. net.

THIS is the first section of a large work undertaken by Prof. G. F. Ferris of Stanford University, who has for many years made a special study of scale insects. The author hopes eventually to deal with every species of scale insect that is definitely established in North America and to make possible their identification. The "Atlas" is primarily a collection of well-reproduced plates of admirably clear drawings illustrating each species, with brief notes on synonymy, hosts and distribution, habit, and the chief recognition characters; and the matter concerning each species can, if desired, be obtained separately in loose-leaf form.

In an interesting introduction describing the plan and basis of the work, Prof. Ferris also discusses the system of classification adopted. He considers that the old family Coccidae "must be stepped up at least to a super-family", Coccoidea, within which he recognizes eleven families occurring in North America. Among these, the Diaspididae is divided into the sub-families Diaspidinae and Phoenicococcinae, and the volume under notice deals with the tribe Diaspini of the former sub-family. This covers some 34 genera, including species of *Aulacaspis*, *Chionaspis*, *Diaspis*, *Epidiaspis*, *Lepidosaphes* and *Parlatoria*. The debatable problem of the genera to be accepted is shortly discussed, the author admitting that it "cannot be settled to the satisfaction of everyone, or perhaps even of anyone, the author included". About a hundred species in all are illustrated and, as a rough estimate, it is thought that the complete "Atlas" will include perhaps 750 species.

The difficulties of identification of scale insects are considerable, but they are a highly interesting group from the taxonomic point of view and have the added attraction that many species are of great economic importance and wide distribution as pests. In spite of this their study has been much neglected, and all who are interested will be grateful to Prof. Ferris for undertaking the valuable publication, which should prove a stimulus to further work.

Some Beautiful Indian Trees

By the late Rev. E. Blatter and Walter S. Millard. Pp. x+110+68 plates. (London: John Bale, Sons and Curnow, Ltd., 1937.) 21s. net.

THIS book represents the elaboration of materials already published in the *Journal of the Bombay Natural History Society*. 31 beautiful coloured plates, 35 full-plate photographs and 42 line drawings in the text of 108 pages are ample and excellent illustrations for the guidance of those who desire to acquaint themselves with some of the striking trees that are frequently met with in the plains of India. Detailed descriptions of the more common species have been given, together with notes on their distribution, economic uses and gardening. A long list of popular names has also been added. Suitable English names of some of the species have been coined. The generic name is followed by an appropriate explanatory note. The book is nicely bound and well printed.

But such rich materials lack in proper arrangement and uniformity in the treatment of families, genera and species dealt with in this volume. Such want of sequence in the subject-matter is a bit confusing to the reader. Notes on distribution might have been made more useful by incorporating further details of localities by consulting herbarium specimens of different parts of India and Burma. The lists of popular names in some cases are too long. The names of some of the species require slight modification in the light of the international rules of botanical nomenclature.

The book is entitled "Some Beautiful Indian Trees"; but some of the species dealt with are not indigenous to India.

Although there is room for several improvements in the book, yet it is indeed a laudable attempt on the part of the authors towards better recognition of some of the attractive Indian trees. The volume is a valuable addition to the Indian botanical publications. It will undoubtedly prove useful to the lovers of plants, both Indians as well as foreigners visiting India.

Mytilus

By Kathleen M. White. (Department of Oceanography, University of Liverpool: L.M.B.C. Memoirs on Typical British Marine Plants and Animals, 31.) Pp. vii+117+10 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1937.) 9s. net.

SIR WILLIAM HERDMAN did a good day's work forty years ago when he planned out for the Liverpool Marine Biological Committee the series of papers

known ever since as the "L.M.B.C. Memoirs". They have put on record, in more or less detail, the structure and natural history of one common animal after another—no small service; for, as Huxley once said, if the commonest of our British animals became suddenly extinct, we should find we knew next to nothing about many of them. The writing of these memoirs has trained the prentice hand of many a naturalist, among them Ashworth and James Johnstone, Cole, Dakin, Eales, Fleure, Hickson, Imms and Punnett. A new part still comes out every now and then, and No. 31 has just appeared; it is by Miss Kathleen White of Reading, on the common mussel.

Abundance, cheapness and convenient size all fit *Mytilus edulis* for students' use, but it is not very easy to dissect—until you know how. Miss White gives a clear and full account of its anatomy, with the part on the circulatory system particularly good; her figures are excellent, and her brief instructions for dissection are very much to the point. There have been several other monographs on the mussel since de Heide wrote a book on its anatomy two hundred and fifty years ago. Seventy years ago Sabatier began an elaborate study, but never finished it; Field wrote a better and more complete one in a bulletin of the U.S. Fisheries Bureau; now Miss White has given us the best and handiest of them all.

Biology for Students of Pharmacy

By E. J. Moore. Pp. vii+415+8 plates. (London: Edward Arnold and Co., 1937.) 15s. net.

ELEMENTARY biology is one of the basic subjects for several types of students reading for professional degrees or diplomas such as in agriculture, medicine, dentistry, pharmacy and so forth. A general elementary course in biology should satisfy all needs, yet since most professional examining bodies set their own syllabuses, he would be an ambitious author who attempted to satisfy all requirements in one text-book.

A course which is really a combined one of botany and zoology is not the kind of biology which meets with approval to-day; but the author of this book disarms this justifiable criticism of his work by stating explicitly that "the arrangement of the chapters has been decided partly by the fact that the published syllabus [of the Preliminary Scientific Examination of the Pharmaceutical Society of Great Britain] is divided into plant and animal sections". So he wisely follows the syllabus.

This enforced failing aside, the book can be described as excellent. It is quite clear that the author takes his subject as a serious teacher and has not merely compiled his book from other publications or teaching schedules. The text is quite up to date and very lucid, and the two hundred diagrams and eight plates are so clearly produced and labelled that every student of pharmacy can be sure of getting as much out of the book as he requires.

Teachers and students of biology in the pharmaceutical departments of colleges and universities would do well to consider adopting this book as their standard.

Chemistry

Chemical Principles with particular Application to Qualitative Analysis

By Prof. John H. Yoe. Pp. ix+311. (New York: John Wiley and Sons, Ltd.; London: Chapman and Hall, Ltd., 1937.) 13s. 6d. net.

THE keynote of this book is the correlation of reactions and phenomena encountered in qualitative analysis with the student's training in the theoretical principles of inorganic and physical chemistry. All teachers recognize that qualitative analysis should form a part of the student's training, and too frequently it remains almost a separate compartment of the student's knowledge with little or no correlation with the rest of his chemical knowledge.

Prof. Yoe's book is comprehensive. There appears to be no type of reaction or physico-chemical phenomenon likely to be met with in a well-directed course of qualitative analysis but what is discussed. For example, the nature of solution, oxidation-reduction reactions, co-ordination and stereoisomeric co-ordination compounds, neutralization and hydrolysis, theory of indicators, determination of hydrogen ion concentration, the preparation and properties of colloids, adsorption phenomena, crystal structure, atomic structure and even the quantum theory are some of the topics dealt with. To most chapters there are illustrative set problems, answers being supplied to the numerical ones.

Bearing in mind the size of the book, the range of its contents is surprisingly large. In some cases the result is a lack of clarity undoubtedly due to too great compression. An example of this is the chapter on the electrical theory of matter, radioactivity and atomic structure, which occupies rather less than seven pages, in which the neutron is not specifically mentioned.

As an introduction to specialized text-books and monographs, for which all students do not have time or inclination to study, such a book as this has a useful place in the student's library. C. S. G.

Quantitative Pharmaceutical Chemistry:

containing Theory and Practice of Quantitative Analysis applied to Pharmacy. By Prof. Glenn L. Jenkins and Prof. Andrew G. DuMez. (McGraw-Hill Publications in Pharmacy.) Second edition. Pp. xxv+466. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21s.

THE gratifying reception accorded to this excellent text-book on its first appearance has led the authors and publishers to issue a new edition, which has been largely revised in order to bring the subject-matter into conformity with the many changes made in the official methods of analysing pharmaceutical materials in the latest issues of the United States Pharmacopoeia and the National Formulary. The theoretical matter has also been brought up to date, while the number of assay exercises has been increased. In addition, the contents have been rearranged, being now divided into three parts instead of four as in the original edition. This compression has been achieved by

deleting the section on ultimate analysis and by incorporating the chapters on pH determinations, electro-analysis, etc., which originally represented non-official procedures, with the other physico-chemical determinations such as refractive index, specific rotation, etc. These are now all contained in Part 2, while, as before, Part 1 deals with gravimetric, volumetric and gasometric methods. The third section is devoted to special procedures such as the assay of alkaloids and volatile oils and the determination of the constants of fats, waxes, resins and balsams.

The volume is well written and produced, and although all the methods advocated are not official in Great Britain, nevertheless they will be found useful to those who are interested in the application of quantitative analysis to pharmaceutical materials.

G. R. D.

The Drama of Chemistry:

How Man deals with Atoms. By Prof. Sidney J. French. (The University Series: Highlights of Modern Knowledge.) Pp. vii+170. (New York: The University Society; London: Chapman and Hall, Ltd., 1937.) 4s. 6d. net.

It requires confidence and wide knowledge to give a stimulating account in a small space of the work of the chemist through the ages, to discuss something of the future of the science and to suggest how a more detailed knowledge of it may be obtained. Dr. French has tackled his difficult task boldly.

The section dealing with organic and biological chemistry is not so satisfactory as those portions dealing with phenomena of solution and with atomic structure. Certain drawbacks are inevitable in a work of this kind. Formulae of some organic compounds need revision and expansion, and the account of Pasteur's resolution of racemic acid is inaccurate. The author surely does not believe that sucrose has been synthesized, that amino acids cannot be condensed together and that Willstätter had nothing to do with the elucidation of the structure of chlorophyll!

It may also seem strange that an account of the development of our knowledge of atomic structure can be given without mentioning the names of Sir J. J. Thomson and Lord Rutherford. While later workers are referred to, Prof. F. Soddy's pioneering work on the isotopic forms of the elements is overlooked. On the other hand, "Henry Armstrong", according to Dr. French, was famous for having dared to oppose Arrhenius's dissociation theory and is described with Louis Kahlenberg as being "chief among the hardy rebels".

In spite of these criticisms, Dr. French has given us a most readable and brief account of what he aptly describes as "The Drama of Chemistry".

C. S. G.

Practical Organic Chemistry

By A. J. Mee. (Dent's Modern Science Series.) Pp. x+284. (London: J. M. Dent and Sons, Ltd., 1937.) 5s.

THE author has managed to compress nearly three hundred experiments into this little volume, which is intended to be used in conjunction with a text-book

dealing with the underlying theories. The aim has been to provide a course of instruction in practical organic chemistry up to pass degree standard, consisting of preparations of compounds, arranged to illustrate the main groupings of the subjects and of typical reactions of many of the prepared compounds. Two short chapters at the end deal respectively with the application of dyestuffs and the identification of unknown compounds. Quantitative analysis has been omitted. A very useful feature of the book is the inclusion at the beginning of some of the chapters of tables showing the chemical relationships of the products described.

It is rather surprising to find the old-fashioned method of drying glassware with alcohol and ether mentioned. In Fig. 16 the positions of the manometer and the safety-flask might have been interchanged and the use of rubber stoppers avoided entirely. In testing for the elements, Lassaigne's reaction with sodium often fails; Middleton's reagents (sodium carbonate and zinc dust for nitrogen and pure sugar and sodium carbonate for sulphur and the halogens) are both safer and more satisfactory. The book covers a fairly wide field and the instructions are very clear and concise.

Engineering

Aerodynamics

By Dr. N. A. V. Piercy. Pp. xvi+423. (London: English Universities Press, Ltd., 1937.) 30s. net.

DR. PIERCY has, to use a hackneyed phrase, "fulfilled a long felt want" in producing this book. Although there are several excellent English books on aerodynamics, the exceptional rate at which the applied outlook of the subject has developed recently has left a distinct gap in text-book literature, although such information is available in a more scattered form in periodicals, Government publications, etc. Students and professional technicians will certainly find this volume an indispensable companion.

In keeping with the breadth of his title, the author attempts to survey the whole field of his subject, and merely because of lack of space fails to do some parts of it justice. This is a pity, in a book from so able an author and unquestionable an authority as Dr. Piercy, but on the other hand the treatment is logical. Discussions start *ab initio*, and treat the subject properly up to a certain point. This makes a book that appeals to the student rather more than to the professional aerodynamicist. Is it too much to hope that this will be followed by a second volume with a more practical aspect?

Such matters as the rotating wing, interference, movements of the transmission point and the measurement of profile drag, the empirical treatment of the subject of skin friction and the boundary layer, are a few of the questions that aircraft designers need to see treated from their applied point of view. The last chapter, dealing with the analysis of performance, is exactly what is required by the practical reader, and provokes one to hope for more of this sort of treatment in either an extra volume or a second edition.

Engineering Properties of Soil

By C. A. Hogentogler, with the collaboration of Henry Aaron, Richard C. Thoreen, Edward A. Willis, and Adolph M. Wintermyer. Arranged and edited by C. A. Hogentogler. Pp. xiii+434. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30s.

SOILS are a subject of interest to a large circle of investigators, since they play an essential part in most human activities. Not least are they of importance to the engineer, who has to deal with them as foundations and as materials for his structures. A text-book on these aspects of their utility is therefore not only justifiable but also eminently desirable, and the authors of this joint compilation have produced one on clear and comprehensive lines. Part 1 of the volume deals with the origin and composition of soils; Part 2 with the characteristics of soil; Part 3 with the structural properties of soil; and Part 4 with practical design and construction. The chief author and his collaborators are highway engineers in the service of the United States Bureau of Public Roads: their point of view, therefore, as well as the sources of their data, is naturally mainly American, as is evidenced throughout the volume in nomenclature and classification and in the fairly extensive bibliography at the end. The book is well illustrated with diagrams, and there is a glossary of geological terms as well as a serviceable index.

B. C.

An Introduction to Fluid Mechanics

By Alex. H. Jameson. Pp. x+239. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 7s. 6d. net.

RECENT developments in aeronautics, the turbine and the use of liquid and gaseous fuels have produced a great change in the science of fluid mechanics. As a consequence, an elementary knowledge of the modern advances in the subject is now required by engineering students. This book has therefore been written for the use, primarily, of second year students preparing for the London engineering degree. The author has made a special feature of keeping the course as free as possible from empirical formulae and tables of coefficients. The text is well illustrated by clearly drawn diagrams and fully worked-out examples. Both the calculus and the method of dimensions have been used wherever necessary, and although the book is designed to cover adequately a specific syllabus, it should be very useful to all engineering students.

Storage Reservoirs

By George Bransby Williams. Pp. ix+293+24 plates. (London: Chapman and Hall, Ltd., 1937.) 25s. net.

WITHIN the modest compass of 300 pages, Mr. Bransby Williams has succeeded in compressing a very comprehensive and up-to-date survey of a subject the full development of which would require a number of volumes. The survey is necessarily

brief and compact, covering as it does a wide range of topics: rainfall, off-flows (or run-offs) and storage capacities; flood discharges and spillway capacities; masonry gravity dams; single arch masonry dams; multiple arch and reinforced concrete dams; earth, hydraulic-fill and rock-fill dams; regulation of storage and reservoir features (including power stations); methods of construction and treatment of water for domestic supplies. In addition to these technical matters, the author finds space to conclude with what he terms an Engineer's Odyssey, being an account of a tour around the dams and reservoirs of Great Britain. Having occupied the post of chief engineer in the Public Health Department of the Government of Bengal, Mr. Williams naturally gives prominence to water storage installations in India, but his survey is representative of the most modern practice in other countries. There are a number of diagrams and some photographs.

B. C.

Philosophy and Psychology

Theory and Art of Mysticism

By Prof. Radhakamal Mukerjee. Pp. xvi+308. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 15s. net.

A BOOK ON Oriental mysticism—which being traditional is essentially sound—is nowadays of an actual as well as of a general interest. Europe is suffering to-day from crude and brutal mysticisms; obsessed by an apparently overpowering need of spiritual surrender; the desire for a crazy submission to 'leaders' with a false mythological halo and a perverted racial or nationalistic background. The understanding of how this mental attitude has come upon us in our Western world, what it means, and what it portends for the future, is perhaps the most vital problem of modern social science.

This book, written by one of India's foremost scholars, himself fully in sympathy with the mystical point of view, will be a great help towards the understanding of mysticism in general. The chapters which deal with the "training in the art of contemplation" will assist us in grasping the inner attitude of the mystic. Dr. Radhakamal Mukerjee has already established a world-wide reputation as an economist. He is also a distinguished scholar in social science. The width of outlook and the richness of literary and factual evidence save the work from the one-sidedness from which a piece of special pleading might suffer. The introductory chapters on the foundations of religion, on its primitive manifestations, on magic and ritual, reveal the writer's competence in dealing with anthropological problems. The discussion of the relation between religion and economic life is of special interest because here his appreciation of mysticism and his professional knowledge mingle and cross-fertilize each other. The book will therefore be of value to the student in political science, the economist, and also of course to the philosopher concerned with the history of religion.

B. M.

The Philosophy of Relativity

By Prof. A. P. Ushenko. Pp. 208. (London: George Allen and Unwin, Ltd., 1937.) 8s. 6d. net.

So many books have been written on this important subject that one may almost doubt whether anything really new can be said about it. Yet Prof. Ushenko succeeds in being both interesting and new, thanks to his method of treatment of the theory of relativity. To begin with, he wants philosophers to understand what the mathematics of relativity mean: so in Chapters ii and vi he gives a step-by-step deduction of the main equations of relativity. Then he goes on to give a critical account of the meaning of these equations. He bases his discussion on the fact that events are described by dispositional characteristics, and that they must have an essence which is distinct from these characteristics. For him, this essence is a fusion of space with time, thus rejecting physical substance as an alternative category of natural philosophy, and involving an attitude which is antagonistic to the new positivistic tendencies.

T. G.

Physics

Electrolytic Condensers:

their Properties, Design and Practical Uses. By Philip R. Coursey. Pp. viii+172+10 plates. (London: Chapman and Hall, Ltd., 1937.) 10s. 6d. net.

THOUGH the development of the electrolytic condenser goes back quite a long time, it is only in recent years—mainly through the demand of the wireless industry—that they have reached their present important position. Mr. Coursey's book is the first one published in English on this subject. It is, in the first place, intended for the prospective user, that is, for designers of apparatus incorporating such condensers.

This explains the mode of treatment adopted—in combination with the restraint which the author had to impose on himself as technical director of a firm manufacturing these condensers. We find a bare minimum of information on the physico-chemical processes underlying the action of the condenser, a general survey of the various types of construction and of their electric properties, and a fairly detailed description of the methods used for testing and of the points which have to be considered when selecting a condenser for some definite purpose. The electric properties in question are illustrated by numerous curves, many of which are characteristic; all are, however, presented in a way which makes identification with definite types of condensers or experimental conditions impossible. In order to reach as wide a public as possible a rather elementary mode of presentation has been adopted. There are few references to patents or literature, those given dealing nearly all with circuit problems.

The book will be definitely useful to the research worker who wishes to employ this type of condenser in his experimental apparatus.

A. B.

Alternating Current Measurements at Audio and Radio Frequencies

By Dr. David Owen. (Methuen's Monographs on Physical Subjects.) Pp. vii + 120. (London: Methuen and Co., Ltd., 1937.) 3s. 6d. net.

THIS new addition to Messrs. Methuen's well-known series of monographs is devoted to the principal methods used for the measurement of frequency and circuit constants for alternating current in the audio and radio frequency range. Its main contents are as follow: introduction to the treatment of A.C. circuits by vector methods and complex notation, measurement of inductance (self and mutual), capacity and frequency at audio frequencies, mainly by the use of bridge methods, including, however, a special chapter on A.C. potentiometers; measurement of the same magnitudes at radio frequencies by resonance methods. The author, who with the 'Owen bridge' has himself made a definite contribution to the subject, has succeeded in presenting the matter with agreeable shortness, outlining well the points which should be observed in the experimental procedure. Numerous examples, worked out in detail, add to the usefulness of the book by illustrating the order of magnitudes and errors encountered.

A. B.

Miscellany**Interpretative History of Flight:**

A Survey of the History and Development of Aeronautics, with Particular Reference to Contemporary Influences and Conditions. (Board of Education: Science Museum.) By M. J. B. Davy. Pp. 208 + 31 plates. (London: H.M. Stationery Office, 1937.) 5s. net.

THIS is a fourth volume written by Mr. Davy, of the Aeronautics Section of the Science Museum, South Kensington, which, although not directly descriptive of the exhibits there, is based upon the historical aspect of such an exhibition, and might well be read in conjunction with a visit to it.

The book describes the continuous development of the idea of flight and provides a record of the human activities leading to its achievement. The subject has been dealt with from a somewhat new point of view in that the outstanding phases, facts, and events are explained with reference to the contemporary conditions and the general trend of human development, it being felt that there exists a need for the presentation of this subject in a form which embraces more than bare facts and technical details unrelated to the social and economic background.

It is divided into three parts, and is fully illustrated with contemporary prints and photographs. Part 1 deals with the principles of natural flight and the early history of man's attempts. Part 2 treats the period from the beginning of definite historical records up to the end of the Great War in 1919, that period in which flight was first conceived, then achieved, and afterwards developed towards the wartime outlook exclusively. Part 3 covers the post-War applications to the various transport activities,

and speculates upon the social and economic aspects of the question.

This is a thoroughly readable book, written by an author who is in a position to be, and is, a master of his subject.

Prosperity Beckons:

Dawn of the Alcohol Era. By Dr. William J. Hale. Pp. viii + 201. (Boston, Mass.: The Stratford Co., 1936.) 2 dollars.

THE interdependence of industry and agriculture is gradually gaining wider recognition, but current conceptions of agriculture are largely dominated by inherited views of its functions. In this spirited forecast of the possibilities of an era in which alcohol will largely displace petrol and other hydrocarbons as fuel for the internal combustion engine, as a result of developments from the discoveries of Bergius on the hydration of cellulose and Hertz on the isolation of α -cellulose from wood pulp, the author discards such conceptions. The production of food, he suggests, is a purely secondary matter. A fifth of those engaged at present in agriculture could supply all our needs in respect of food and clothing. Agriculture's main business in the future should be the provision of raw materials for industry, especially raw alcohol, or as he terms it, "agrierude alcohol", and the crops to be cultivated should be determined primarily by industrial needs.

In a style which at times borrows too much from the devices if not the jargon of the publicity agent, Dr. Hale gives much food for thought, and the possibilities of advance in the direction he indicates deserve serious attention. His argument for a closer relation between the factory and the farm is reinforced not only as a contribution to the unemployment question and by the importance of utilizing the vast quantities of agricultural waste products, but also by the general tendency of economic nationalism to seek substitutes for materials imported from abroad. At a time when determined effort to formulate a genuine agricultural policy for this country related to the conservation of all its natural resources is long overdue, the book should appeal to all scientific workers who are considering the contribution of science in this field.

Noise

By Dr. A. H. Davis. (Changing World Library, No. 6.) Pp. x + 148. (London: Watts and Co., 1937.) 2s. 6d. net.

THE author is well known for being in the forefront of noise studies. The present little book is suitable for the scientific worker who has not yet become acquainted with the many aspects of the noise problem, and for the general reader, who ought to be impressed by the manner in which a social problem can be attacked when treated scientifically. The measurement of noise level and the definition of the phon scale are carefully explained, but the feature of this little book is the amount of well-balanced information which is presented in such agreeable terms.

L. E. C. H.

Forthcoming Books of Science

Agriculture, Horticulture and Forestry

- Clarendon Press and Oxford University Press.* Practical British Forestry—C. P. Ackers.
English Universities Press, Ltd. The Vegetable Garden—W. E. Showell-Cooper. The Herbaceous Border—R. Sudell.
Faber and Faber, Ltd. Pig Breeding and Feeding—C. Forman.
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Thomas Murby and Co. Soils of the Lusitano-Iberian Peninsula—Prof. E. H. del Villar. International Soil Map of Europe, 1: 250,000.
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Observations made in hydrogen light ($H\alpha$) with the Hale spectrohelioscope at Greenwich Observatory showed considerable activity within the spot. Besides the occurrence of several minor eruptions, bright eruptions of large extent were observed on September 29 at 10^h 50^m until 11^h 50^m U.T. and on September 30 at 10^h 28^m until 11^h 30^m. The times of maximum intensity of these eruptions agree closely with those of pronounced fadeings in short-wave wireless transmission as recorded in Great Britain and elsewhere. A magnetic disturbance was registered at Abinger from October 3^d 11.3^h until October 4^d 9^h, and an aurora was reported from the Southern Coast of England on the night of October 3-4.

Announcements

PROF. JOJI SAKURAI, president of the Imperial Academy and of the National Research Council of Japan, has been elected vice-president of the International Council of Scientific Unions in succession to the late Marchese Marconi.

GEN. MED. RAT DR. HANS VIRCHOW, emeritus professor of anatomy of the University of Berlin, celebrated his eighty-fifth birthday on September 10, and Dr. Karl Jacoby, emeritus professor of pharmacology and physiology of the University of Tübingen, was eighty years of age on September 12.

THE July issue of the *American Journal of Roentgenology and Radium Therapy* is dedicated to Dr. Henry K. Pancoast, in honour of his twenty-fifth year as professor of roentgenology at the University of Pennsylvania. Dr. Pancoast has served as president of the American Roentgen Ray Society, of the American Radium Society and of the first American Congress of Radiology held at Chicago in 1933.

MISS E. A. LANGLEY, at present organizer of school meals for the London County Council, has been appointed to fill a new post on the staff of the Board of Education as inspector of the arrangements made by local education authorities for the provision of meals. She will co-operate with the Board's medical staff in the campaign for improving the nutrition of school children.

A GRACEFUL tribute to the value of the scientific radio research conducted within the Empire has been recently paid by Mr. J. W. O. Hamilton, who has offered sums to found prizes for radio research at the Universities of Cambridge, Melbourne, Sydney and Tasmania. In his letter to the Vice-Chancellor of the University of Cambridge, offering the sum of £500 for this purpose, Mr. Hamilton has expressed a desire that the names of James Clerk Maxwell and Sir Ambrose Fleming, both Cambridge men, should be associated with the prize.

THE Quekett Microscopical Club is holding a conversazione in the rooms of the Royal Society, Burlington House, Piccadilly, W.1, on Tuesday, October 12, at 7.30.

A SPECIAL course of nine lectures will be delivered at the London School of Economics and Political Science by Bertrand Russell on "The Science of Power" on Mondays at 5 commencing October 11. Further information and forms of application may be obtained from the Secretary, London School of Economics, Houghton Street, Aldwych, W.C.2.

A CONFERENCE on Rubber Technology will be held in London on May 23-25, 1938, under the auspices of the Institution of the Rubber Industry. The president will be Mr. S. T. Rowe. The Conference will be divided into two parts: (1) Methods of Improving and Evaluating the Durability of Rubber; and (2) General Subjects. Further information can be obtained from Mr. W. F. V. Cox, Institution of the Rubber Industry, 12 Whitehall, London, S.W.1.

A GENERAL DISCUSSION on Lubrication and Lubricants, under the auspices of the engineering and technical institutions of Great Britain, is being held on October 13-15. It has been found necessary, owing to the large numbers of applications for membership, to arrange for the discussion to be held in the Central Hall, Westminster, London, S.W.1. In conjunction with the discussion an exhibition will be held at the Science Museum, South Kensington, S.W.7. The exhibits will include lubricants, bearings, applications of lubrication, filtration, testing and research, as well as an interesting series of exhibits from the Science Museum collections. The exhibition will remain open until October 31.

A CHAIR of the history of medicine has recently been founded at Buenos Aires with Prof. Juan Ramón Beltrán as its first occupant.

THE annual meeting of the International Society of Medical Hydrology, which is open to non-members, will be held at Frankfort-on-Main and the neighbouring spas on October 17-22, when the subjects for discussion will be bioclimatology, psychological factors in health resort practice and the natural history of peats and muds. Further information can be obtained from the secretary, 109 Kingsway, London, W.C.2.

THE twenty-fourth French Congress of Hygiene will be held at the Pasteur Institute, Paris, on October 18 and 19 under the presidency of Dr. E. Lesné, member of the Academy of Medicine, when the subjects for discussion, among others, will be school hygiene and wholesome milk. Further information can be obtained from Dr. R. Dujarric de la Rivière, Institut Pasteur, 28 rue du Docteur Roux, Paris 15^e.

ERRATUM. Referring to his letter "Transitive Interference in Gene Linkage" in NATURE of August 21, p. 322, Prof. K. de Kőrösy writes stating that the table on p. 323 contains a misprint overlooked by him in the proof; in column c, line g, for 0.279 read 0.249.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 646.

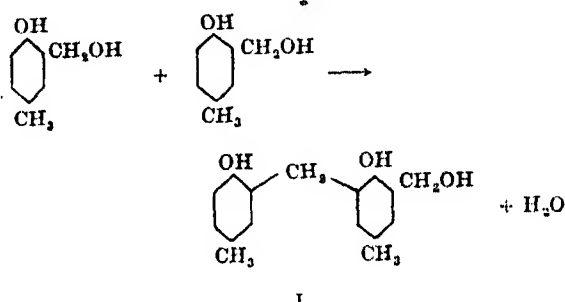
CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Examination of Synthetic Resins by X-Rays

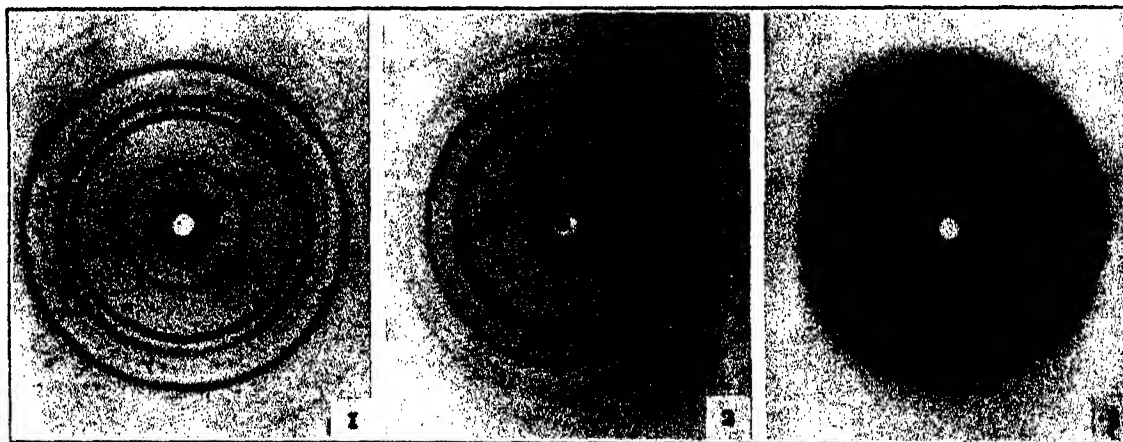
WE have attempted to study the process of resinification by following with the aid of X-ray diffraction the transitional stages of structure taking place in an initially crystalline compound which on heating forms a resin. Well-known substances of this type are the phenolic alcohols, which on heating form the class of resins termed 'saliretins'. A first result of the X-ray method has been to show that *p*-cresol monoalcohol (2-hydroxy-methyl-4-methylphenol) changes over at an intermediate stage to an apparently new compound to which this note directs attention.

The X-ray transmission spectrum of the initial material is shown in Fig. 1. After heating the substance under a pressure of 17 mm. of mercury for 30 minutes at 130°, the spectrum of the cooled product changes to that shown in Fig. 2, where the original rings, except for faint traces, are replaced by others. The new rings resemble the originals in a

cent; H, 6.98 per cent). It appears to be formed as follows, and to function as a true intermediate:



In addition to the detection of the new compound, further X-ray results in this particular case give more



X-RAY DIFFRACTION PHOTOGRAPHS SHOWING THE FORMATION ON HEATING *p*-CRESOL MONOALCOHOL OF INTERMEDIATE COMPOUND AND FINAL RESIN.

general way but have different diameters and, therefore, indicate a new structure. The isolation of a new compound by fractional extraction with light petroleum, from which it crystallizes in flakes melting at 99–100°, supports this conclusion. The nearness of this melting point to that of the initial material (105°) probably explains in part why the new compound has not previously been noted. The compound has tentatively been assigned the formula 3-hydroxy-methyl-2 : 2'-dihydroxy-5 : 5'-dimethyl-diphenylmethane (I) (found : C, 74.8 per cent; H, 7.29 per cent (micro-analysis); $\text{C}_{16}\text{H}_{16}\text{O}_2$ requires, C, 74.4 per

definite information than usual upon the structure of the resin itself. It will be noted that the characteristic feature of Figs. 1 and 2 is a strong inner ring followed by a gap and then a group of outer strong rings. Now the spectrum of the resin taken under the same conditions, and shown in Fig. 3, shows unmistakably the same characteristics. There is a strong central halo corresponding to the inner ring of Fig. 2 and two outer halos corresponding to the outer rings of Fig. 2. The resin is, therefore, not amorphous but a distorted crystal structure with a molecular arrangement essentially similar to that of the crystalline

intermediate. The resin is, therefore, formed structurally by small irregular relative displacements of the molecules from the crystalline formation and not by radical rearrangement of a random nature.

The size of the unit cell of *p*-cresol alcohol and the arrangement of molecules therein will be described in a more detailed communication.

This research has been carried out at the instigation of Sir Gilbert Morgan, director of the Chemical Research Laboratory, to whom thanks are due for permission to publish the results, and the X-ray work has been carried out under Dr. G. W. C. Kaye, superintendent of the Physics Department, National Physical Laboratory.

Chemical Research Laboratory N. J. L. MEGSON.
(Dept. of Scientific and
Industrial Research),
Teddington.

National Physical Laboratory W. A. WOOD.
(Dept. of Scientific and
Industrial Research),
Teddington.
Aug. 5.

Chemical Properties of the Rare Gases

It is known that the rare gases argon, krypton and xenon give unstable chemical compounds with van der Waals bonds, namely, the hydrates. They have been obtained by compressing the gas over water at 0° C. In the case of argon, the crystals of the hydrate are formed at a partial pressure of argon of about 100 atm. I have already shown by an independent method¹ that radon, too, forms a hydrate which is much more stable than those of other rare gases. Radon is easily held by crystals of sulphur dioxide hydrates, when they are formed from snow and sulphur dioxide below the eutectic point or recrystallized. The radon hydrate is isomorphous with the hydrate $\text{SO}_2 \cdot 6\text{H}_2\text{O}$, as its distribution between the gaseous phase and the crystal obeys the Berthelot-Nernst law: the ratio Rn/SO_2 in crystals is proportional to the corresponding ratio in the gas:

$$\frac{\text{Rn (crys.)}}{\text{SO}_2 \text{ (crys.)}} = D \frac{\text{Rn (gas)}}{\text{SO}_2 \text{ (gas)}}$$

where the constant D for Rn has the value 0.6.

I have also studied the possibility of an isomorphous 'seizure' of argon and neon by the crystals of sulphur dioxide hydrate, when formed from sulphur dioxide and snow at -8° C. I found that argon is held by this hydrate, and could thus be transferred quantitatively from the gaseous phase into the crystals. The partition factor is constant and equal to 0.007. No neon hydrate (or any other compound of neon) is as yet known. Its dissociation pressure is presumably some thousands of atmospheres. Nevertheless, neon is also taken up by the crystals of sulphur dioxide hydrate, though with greater difficulty than argon. Only 1.2 per cent of neon goes into the crystals after passing ninety charges of sulphur dioxide into a tube containing snow and neon at -8° C., each time about 80 per cent of the sulphur dioxide being deposited as hydrate. Under the same conditions only traces of helium, not more than 0.2 per cent, could be found in the crystals. Consequently neon, too, forms a hydrate, isomorphous with the sulphur dioxide hydrate, of the formula $\text{Ne} \cdot 6\text{H}_2\text{O}$; the constant D for neon is of the order of 0.00005.

Different stability of the rare gas hydrates makes it possible to separate them quantitatively by chemical means. After twelve depositions of sulphur dioxide as hydrate of the order of 60-70 per cent each, more than 99 per cent of radon is transferred into the crystals. By means of a current of sulphur dioxide more than 99.5 per cent of helium and neon, and about 90 per cent of argon, may be separated from crystals containing radon. For a quantitative separation of argon and radon, the hydrate must be decomposed and the separation repeated. For quantitative deposition of argon (98 per cent), 160 depositions of sulphur dioxide hydrate (80 per cent each) are needed. The whole operation lasts 8-9 hours. The depositing crystals seize, chemically and mechanically, no more than 0.5 per cent helium and about 3 per cent neon. Consequently, it is possible to separate chemically argon and radon from helium and neon, and radon from argon. It is interesting to note that the chemical properties of argon are nearer to those of radon than to neon.

B. A. NIKITIN.

State Radium Institute,
Leningrad.
Aug. 26.

¹ Nikitin, B. A., *Z. anorg. allg. Chem.*, **237**, 81 (1936).

Proliferation-promoting Substances from Cells injured by Ultra-violet Radiation

As reported in this journal¹ and elsewhere², fractions which stimulate the growth, fermentation and respiration of yeast have been isolated in our laboratories from cells injured by ultra-violet irradiation, X-rays and other means. The following experiments by a new technique have confirmed the production of proliferation-promoting substances by cells injured by ultra-violet radiation.

Reader's medium solidified with agar was cut into blocks 3 mm. × 5 mm. × 5 mm. Dilute suspensions in Reader's medium from cultures of *S. cerevisiae* grown on Sabouraud's slants were applied to the tops of these blocks. Cover glasses were put over the inoculated areas and sealed to the blocks with agar. The materials to be tested for proliferation-promotion were added to the bottoms of the blocks, and the cover glasses and hanging blocks placed on culture slides ringed with 'Vaseline'. The cultures were incubated at room temperature for 24-48 hours. Areas of growth on the tops of the blocks were then recorded by photomicrographs. The proliferation-promoting materials diffused from the bottoms of the blocks to the cells on top, where they caused increased proliferation.

Effects of the following materials were compared: water, Reader's medium, unirradiated and irradiated yeast suspensions, cell-free fractions from unirradiated and irradiated yeast suspensions, and a highly potent bios preparation from malt comings. Yeast suspensions were prepared by adding 3.5 gm. of baker's yeast to 200 c.c. of Ringer's glucose-phosphate solution. Portions of these were irradiated in quartz test tubes, with constant stirring, by the full ultra-violet from a quartz mercury arc until about ninety per cent of the cells were killed. Cell-free fractions were usually prepared by centrifuging the suspensions for 15 minutes and decanting the supernatant fluid, occasionally by filtration through a Berkefeld filter.

In all experiments, growth on blocks to which ultra-violet injured cell suspensions or cell-free fractions from these had been added was much greater

than on blocks to which unirradiated cell suspensions or cell-free fractions therefrom, water, Reader's medium, or nothing had been added. Bios caused approximately the same growth as the irradiated cell-free fractions. The accompanying table summarizes the results and the photomicrographs (Fig. 1) are typical of the 24-hour cultures. Addition of Reader's medium (not included in the table because it was used in only a few experiments) produced no noticeable effect. The apparent stimulation by cell-free fractions from non-irradiated cells seemed to result from mechanical injury to the cells during centrifuging.

SUMMARY OF EXPERIMENTS

Material added to bottom of block	Per cent of area on top covered with growth		Dry weight of material added to block
	After 24-27 hr.	After 47-48 hr.	
Non-irrad. cell suspension	7.1	16.2	0.025 mgm.
Water	7.8	10.5	
Nothing	9.3	29.5	
Cell-free fraction from non-irrad. cells	14.8	no data	0.0011 mgm.
Irrad. cell suspension	30.6	70.3	0.025 mgm.
Cell-free fraction from irradiated cells	37.1	79.2	0.0038 mgm.
Kreke's bios prep. No. 14	41.4	no data	0.0037 mgm.

Ultra-violet absorption spectra of cell-free fractions from irradiated and non-irradiated cells showed considerable difference. Those of irradiated fractions were similar to the spectra of proliferation-promoting factors from yeast and irradiated liver cells reported previously².

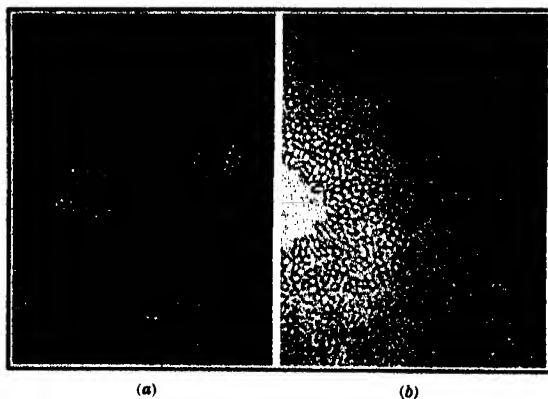


Fig. 1.

PHOTOMICROGRAPHS OF TOPS OF AGAR BLOCKS AFTER 26 HR. (a) NON-IRRADIATED CELL SUSPENSION ADDED TO BOTTOM OF BLOCK. (b) IRRADIATED CELL SUSPENSION ADDED TO BOTTOM OF BLOCK.

We believe the proliferation-promoting factors produced by ultra-violet injured cells afford a clue to the explanation of wound healing and possibly of certain types of malignancy, as will be discussed more fully elsewhere.

GEORGE SPERI SPERTI.
JOHN R. LOOFBOUROW.
CECILIA MARIE DWYER.

Institutum Divi Thomae Graduate School
of Scientific Research,
Cincinnati, Ohio.
July 15.

¹ Fardon, Norris, Loofbourow and Buddy, *NATURE*, 139, 589 (1937).

² Fardon, Carrol and Buddy, *Studies of the Institutum Divi Thomae*, 1, 17 (1937). Fardon and Buddy, *ibid.*, 1, 41 (1937). Norris and Buddy, *ibid.*, 1, 53 (1937).

³ Loofbourow, Schmieder, Stimson and Dwyer, *Studies of the Institutum Divi Thomae*, 1, 79 (1937).

Infra-Red Spectrum of Tetradeuteroethylene

THE molecule C_2D_4 has twelve fundamental modes of vibration, of which six should be observable in Raman scattering, five in infra-red absorption, while the remaining one must be deduced from combination frequencies in the infra-red or from measurements of specific heat. A knowledge of those is of considerable interest in the theory of molecular vibrations (a) as a qualitative check on the assignment of the fundamental frequencies of the C_2H_4 molecule, (b) as a test of various potential functions which have been advanced to correlate the frequencies of C_2H_4 . Of those twelve frequencies, so far only four have been reported, being recently observed in the Raman spectrum by de Hemptinne, Jungers and Delfosse¹. We now wish to report briefly an investigation in the infra-red by which we have identified another four of the twelve fundamentals.

The specimen of C_2D_4 employed was kindly given us by Prof. de Hemptinne of the University of Louvain and contained about 10 per cent of $C_2D_2H_2$. Strong absorption bands were found at 4.28μ , 4.56μ , 9.28μ and 13.85μ ; a weaker band was observed at 6.7μ , while still weaker bands appeared at 8μ and 10.75μ . The stronger bands have all been examined under high dispersion with the exception of that at 4.28μ , which practically coincides with a very strong atmospheric absorption due to carbon dioxide. From the contours obtained it has been possible to make the identifications indicated in the accompanying table. The most puzzling feature is the non-appearance of the frequency ν_8 . This is particularly interesting since the corresponding frequency in C_2H_4 has usually been supposed to coincide with ν_{11} , although it is not easy to distinguish two separate bands in the absorption contour. One might have expected the separation to be quite marked in the deuterio-compound. We have, in fact, observed a distinct double maximum in the band at 13.85μ , but it is not possible to attribute one of these to the frequency ν_8 since the latter should not possess a sharp Q branch. The possible explanations of this double maximum would take too long to discuss here, and will be dealt with elsewhere, as will also the interpretation of the weaker bands.

As regards (b), it is interesting to compare the observed values of the infra-red frequencies with those predicted by using the various potential functions proposed for C_2H_4 . This is done in the table.

C_2H_4 (cm. ⁻¹)	C_2D_4				
	Manneback and Verleyse ²	Sutherland and Dennison ³	Thompson and Linnett ⁴	Bonner ⁵	Observed
ν_1 2988	2153 (1.8)	2220 (1.4)	2101 (3.7)	2150 (1.8)	2192.3
ν_2 1444	1072 (0.5)	1055 (1.9)	1187 (10.8)	1071 (0.6)	1077.4
ν_3 3107	2325 (0.4)	—	2323 (0.4)	2305 (1.3)	2335 ± 5
ν_9 950(?)	678	—	1016	757	?
ν_{11} 950	—	720 (0.6)	—	505 (29)	719.5 724.7

It will be seen that discrepancies between predicted and observed values (which are expressed as percentages in brackets below each frequency) are only of the order expected through the neglect of

anharmonicity (2 per cent), except in the case of two of Linnett and Thompson's, and one of Bonner's predictions. It is also noticeable that an observation of v_2 would be another extremely helpful criterion, since here the predicted values show the widest spread. Work is being continued on the location of v_2 .

G. B. B. M. SUTHERLAND.
G. K. T. CONN.

Laboratory of Physical Chemistry,
Cambridge.
Sept. 6.

¹ de Hemptinne, M., Jungers, J., and Delfosse, J., *NATURE*, **140**, 323 (1937).

² Manneback, C., and Verleysen, A., *NATURE*, **133**, 367 (1936); *Ann. Soc. Scient. Bruxelles*, **B**, **55**, 349 (1936); **57**, 31 (1937).

³ Sutherland, G. B. B. M., and Dennison, D. M., *Proc. Roy. Soc., A*, **143**, 250 (1935); Sutherland, G. B. B. M., *Proc. Roy. Soc., A*, **141**, 355 (1933) for treatment of v_{11} .

⁴ Thompson, H. W., and Linnett, J. W., *J. Chem. Soc.*, 1376 (1937).

⁵ Bonner, L. G., *J. Amer. Chem. Soc.*, **58**, 34 (1936).

Physiology of Nematodes

THE initial success, or failure, of a primary infestation of a host by parasites must be largely the result of the effect on them of the environmental conditions provided by the host, conditions which must also control their distribution within the host. Unfortunately, little is known of the reactions of parasites to definite features in their environment, and in order to help relieve the paucity of our knowledge of these problems, experiments were made with nematodes from the alimentary canal of sheep.

Before the experiments could begin, it was necessary to make an attempt to settle the controversial question of the respiration of parasitic nematodes. Most workers, mainly as a result of experiments with various species of *Ascaris*, believe them to be anaerobic, but I was forced to conclude that nematodes from the sheep, at least, have an aerobic existence. They are killed by periods of oxygen-lack greater than forty-eight hours, even when arrangements are made for any by-products of their metabolism which may have permeated their cuticle to be removed from their environment.

Studying the effect on the nematodes of solutions of varying pH, it was found that the lower limit of acidity tolerated by *Ostertagia circumcincta* (pH 3.2), a species normally found in the abomasum or digestive stomach of the sheep, was not low enough to allow it to live in the stomach of animals such as the dog or horse, or in the abomasum of cattle. The lower limits without adverse effect on the species from the small intestine are not low enough for them to parasitize the abomasum.

In an infestation by nematodes of the small intestine of sheep, the various species inhabit more or less definite regions, each characteristic of the species. It was found that the distance of these 'regions' from the bile duct opening could be correlated with the effect of sodium glycolate and sodium taurocholate on the different species. Thus the peaks of infestation of *Trichostrongylus colubriformis* and *T. vitrinus* occurs within about five feet of this opening, while those of *Nematodirus* sp. and *Cooperia* sp. are not within nine or ten feet of it, and it is *Trichostrongylus* which withstands the greatest concentration of bile salts.

An effort was also made to discover the food of the nematodes—the species dealt with are *Trichostrongylidae* and are not found attached to the mucous

membrane. The demonstration of hæmoglobin within them was not taken as proof of their blood-sucking habits; indeed, the evidence leads to the conclusion that nematodes of the alimentary tract synthesize this substance for themselves, presumably because it is a necessary constituent of their bodies if they are to live an aerobic existence. No definite indication of their actual food was obtained. Bacterial difficulties hampered the experiments, but in one series, when they were overcome by placing *Ostertagia* in an apparatus whereby abomasal fluid could be percolated over the worms, they lived no longer than the controls in Ringer-Locke solution. The attempts at blood-feeding with this species and with those from the small intestine also failed to keep the worms alive longer than 'starving' controls. As yet, only tentative conclusions can be drawn, but it seems that something to be found at or in the mucous membrane of the intestine, possibly the tissue itself, must be incorporated into the experiments before the culture of adult nematodes will be successful.

A full account of the experiments will be published shortly.

D. G. DAVEY.

Institute of Animal Pathology,
University, Cambridge.

Effects of Salts on Emergence from the Cyst in Protozoa

THE physiology of encystment and excystment of Protozoa and other micro-organisms has received little attention. In the case of the ciliate *Colpoda cucullus*, it has been earlier shown¹ that emergence from the cyst, or excystment, is brought about by some special substances present in the excysting medium, which is usually hay infusion. Part at least of the active material was shown to be ether-soluble. We have therefore subjected hay infusion to fractionation in order to isolate and identify the active excysting substance.

It was found unexpectedly, however, that excystment is not due to a special substance but is a property of the salts of a number of organic acids of low molecular weight. There were identified, in the ether extract of an infusion of timothy hay, oxalic, succinic, acetic, fumaric, tartaric, malic and citric acids, these being either isolated or determined by methods in the literature. The potassium salts of all these were active, to varying extents, in causing excystment. Activity is a property of the salts and not of the free acids, potassium and sodium salts being about equally active.

Since activity varies widely among the different acids, this provides perhaps the most favourable opportunity yet known for studying the relation between chemical structure and a biological activity. Preliminary results of this part of the work indicate that, in a homologous series, activity decreases with increasing molecular weight, heptylic and azelaic being the upper limits with mono- and dibasic-acids respectively. Activity is greatly increased by the presence of a hydroxy group in the β -position, but apparently decreased when it is in the α -position.

In an attempt to account quantitatively for the activity of hay infusion in terms of its content of known acids, two important modifying factors have been disclosed. First, the ether-insoluble residue considerably increases the activity of the salts of the various acids, although it possesses little activity

alone. Evidence for this phenomenon, which resembles the interaction of the bios factors in promoting yeast growth, was given earlier¹. This action of the ether residue, we now find, may be imitated by means of a mixture of sugars and phosphate having approximately the same dry weight per cubic centimetre as the ether residue.

Secondly, some of the salts increase the apparent activity of others. In certain combinations this effect may be as large as that of the ether residue, that is, the activity is multiplied about four times. Although even *l*-malate, the most active so far found, shows little activity at the concentration at which it is present in hay infusion, nevertheless in combination with other salts the activity is considerable. A synthetic mixture of potassium salts of the various acids, each at the concentration present in hay infusion, possessed about one sixth the activity of the original infusion, but when in conjunction either with the ether-insoluble residue or with the mixture of sugars mentioned above, this figure is raised to two thirds. Several active fractions from hay infusion remain unidentified; but since the total activity of these is small compared to that of the acids already determined, it is clear that the exciting activity of hay infusion is largely explained on the above basis.

KENNETH V. THIMANN.
A. J. HAAGEN-SMIT.

Harvard Biological Laboratories,
Cambridge, Mass.
Sept. 10.

¹Thimann, K. V., and Barker, H. A., *J. Exp. Zool.*, **69**, 37-57 (1934).

Galileo and Mathematical Demonstration

IN support of his contention that Galileo regarded mathematical demonstration as an *a priori* method of reaching truth, G. J. Whitrow, in his contribution

to the supplement to NATURE of June 12¹, states that my uncle, the late Mr. J. J. Fahie, has shown that "to satisfy his [Galileo's] own mind alone he had never felt it necessary to make any [experiments]". This is a misquotation. In my uncle's book the words are²: "It was in reference to this controversy [on floating bodies] that Galileo declared that ignorance had been the best master he ever had, since, in order to be able to demonstrate to his adversaries the truth of his conclusions, he had been forced to prove them by such a variety of experiments as made himself doubly confident; though to satisfy his own mind alone he had never felt it necessary to make many".

WILLIAM CUSACK FAHIE.

University College,
Dublin.

¹ NATURE, **139**, 1008 (1937).

² Fahie, J. J., "Galileo", p. 145 (1903).

The statement in my contribution to the supplement to NATURE of June 12 is inaccurate, and I apologize for misquoting the late Mr. J. J. Fahie. Actually I did not have access to his original article and quoted from E. A. Burt "Metaphysical Foundations of Modern Science" (2nd edition, Jan. 1932), p. 65, where, in referring to Mr. Fahie's article, the vital word 'any' is misquoted for 'many'. Until receiving Mr. Fahie's letter I was naturally unaware that Dr. Burt had misquoted.

The point I wished to emphasize (owing to the unfortunate misquotation it was over-emphasized) is that *a priori* mathematical reasoning played a much larger part in Galileo's work than is generally realized.

G. J. WHITROW.

Christ Church,
Oxford.

Points from Foregoing Letters

X-RAY photographs indicating changes in the structure and molecular orientation of *p*-cresol mono-alcohol during the process of resinification on heating are submitted by N. J. L. Megson and W. A. Wood. A new crystalline compound (m.p. 99-100°) is first formed apparently by condensation of two molecules with elimination of water. The resin which results on further heating shows signs of a distorted crystal structure, and the authors suggest that it is formed by small irregular displacements of the molecules from the crystalline formation and not by radical rearrangement of a random nature.

B. A. Nikitin states that, as in the case of radon, other rare gases, namely, argon and neon, are taken up in definite proportions by sulphur dioxide hydrate (formed from sulphur dioxide and snow at - 8° C.); he concludes that neon also forms a hydrate, as is known to be the case with argon, krypton, xenon and radon. Different stability of the rare gas hydrates makes it possible to separate chemically argon and radon from helium, and neon and radon from argon.

Photomicrographs showing the growth-stimulating effect upon yeast (*S. cerevisiae*) of substances produced in cells irradiated with ultra-violet light are submitted by G. S. Sperti, Prof. J. R. Loofbrouwer and Sister

C. Marie Dwyer. The authors describe a new technique of testing proliferation-producing substances, and give a table showing comparative effect of irradiated cells, Kreke's 'bios' preparation and controls.

The infra-red absorption spectrum of tetradeuterioethylene has been investigated by Dr. G. B. B. M. Sutherland and G. K. T. Conn, who have thus identified four of the fundamental frequencies of vibration of the molecule.

D. G. Davey discusses certain aspects of the physiology of nematodes from the alimentary canal of sheep. Acidity and the toxicity of bile salts are factors which influence their specificity and also their distribution within their host. He has failed to discover their actual food requirements, but points out that simple immersion in blood or alimentary canal fluid is probably insufficient for their culture *in vitro*.

Emergence from the cyst of the protozoan *Colpoda cucullus*, which takes place in hay infusion, is found by K. V. Thimann and A. G. Haagen-Smit to be due to the presence of potassium salts of certain organic acids (oxalic, succinic, acetic, fumaric, etc.). They find that the ether-insoluble portion of the hay infusion, which by itself is inactive, increased the activity of the organic salt.

Research Items

Pleistocene Relations in East Anglia and Germany

DR. FREDERICK E. ZEUNER, in support of the tentative scheme for the interpretation of the Pleistocene deposits of East Anglia put forward by Prof. P. G. H. Boswell (1932 and 1936) has instituted a comparison of those deposits and those of the Pleistocene of northern Germany (*Proc. Prehist. Soc.*, 3, 1; 1937). There is a remarkable similarity between the two series in (1) stratigraphical sequence, (2) in the palaeontological evidence from the Cromer Forest Bed and that of Mosbach and Mauer, and (3) a fair agreement in the archaeological sequence. In the geological evidence the correlation is as follows: (6) Scottish Readvance—Pomeranian—Würm 3; (5) Hunstanton Brown Clay—Wechsel—Würm 2; (4) Upper Chalky Boulder Drift—Warthe—Würm 1; (3) Great Chalky Boulder Clay—Saale—Riss 2; (2) Norwich Brick-earth and (?) Cromer Till—Elster—Mindel 2; (1) a possible glaciation in late Crag times—a supposed early glaciation of unknown extension—Günz. The evidence from Hoxne is the first from a British station to show a minor interglacial oscillation, which is correlated with the "Pre-Würm", or so-called warm Mousterian, of Germany between Saale and Würm 1. This implies the identification of Hoxne as Riss-Würm and not Mindel-Riss, as has been maintained by some. A comparison of the Cromer Forest Bed fauna with Mosbach and Mauer indicates that it belongs, as they do, to the Günz-Mindel interglacial, while the Crag, affording evidence both geological and palaeontological of a cool climate or even of two cool sub-phases, may be regarded, with some reserve, as Günz. The archaeological succession, beginning with Mr. Reid Moir's Crag industries as Günz, and the Chellean or Abbevillian as Günz-Mindel interglacial, while Clactonian 3 (High Lodge) is assigned to Riss-Würm, is shown to coincide fairly closely with the sequences and their geological correlations in both Germany and France.

Early Sculpture from Iraq

SOME unusual and important examples of early Sumerian and Babylonian sculpture from Iraq acquired for the British Museum (Bloomsbury) by the National Arts Collections Fund have been described and figured by Mr. Sidney Smith (*Brit. Mus. Quarterly*, 11, 3). The earliest in date is a grey granite vase, egg-shaped, with slightly flattened base. The present maximum height is 5½ inches. Beginning ½ inch above the base are three rows of round-topped leaf-like decoration, which often represents mountains; while the circumference at the centre is divided between two groups representing lions, each attacking a bull. The theme and carving show that this vase is closely connected with a limestone libation vase now in the Bagdad Museum found at Erech, stratum III. This fixes the date as the period of the polychrome pottery called Jemdat Nasr ware, before the archaic Sumerian period. A steatite bowl, 7 inches in diameter, 4½ inches high, is carved on the outside in continuous low relief, which breaks up into separate groups, representing several acts, or different parts of a ritual, the connexion of water, bulls, snakes, vegetation, pointing to a rain-

making ritual. Apart from its exceptional artistic merit, the bowl is of interest from the historical point of view. It is not later than the early part of the Agade period, about 2500 B.C., and it may be earlier. The appearance of Indian bulls on a local piece of work shows that close trade connexions led to an interchange of religious ideas. Secondly, the appearance of marked astral symbolism is important, because ordinarily Early Dynastic monuments show no such symbols, whereas they appear on the seals of early Indian type in some profusion, and in the same obscure connexion as on the vase. At present there is nothing improbable in the hypothesis that astral symbolism came into Sumer in the Early Dynastic period, through contact with the ancient civilization of India.

Movement within *Paramecium* Fragments

IN the usual protoplasmic streaming, or cyclosis, within *Paramecium*, the whole space of the endoplasm is occupied by a counter-clockwise movement, the cause of which has not yet been adequately interpreted. Teruhiko Hosoi narcotized *Paramecium* (caudatum type) by iso-propylalcohol and then cut the animals transversely into two parts at different levels (*J. Fac. Sci. Imp. Univ. Tokyo, Zoo.*, 4, 299; 1937). In each cut portion of whatever type cyclosis took place in the same direction as in the intact animal and without any marked change in the rate of flow after the injurious effect due to dissection had subsided. The author suggests that the motive force of the movement may lie in special substances attracted to the intersurface between the ectoplasm and the endoplasm and thus may lie along the entire course of the cyclosis.

Antarctic Polychaetes

A STUDY of the polychaetes collected by the Belgica Antarctic Expedition of 1897-99 was begun by M. Pruvot many years ago, and by 1905 he had made numerous notes and drawings on the Aphroditidae. His death unfortunately took place before the work was ready for publication, and thus it happens that it is only now that Prof. P. Fauvel has ably edited and brought together those observations and drawings of Pruvot's, which are still of interest to-day ("Résultats du Voyage de la Belgica en 1897-99". *Rapports scientifiques: Zoologie. Polychètes* par Pierre Fauvel. Anvers, 1936). Prof. Fauvel has in addition completed a description of the collection. At the time when it was originally made, more than a dozen species were new to science, but during the years that have elapsed since then most of them have been described in the reports of other expeditions, leaving three only to be here recorded as new. The Belgica records are, however, valuable in that they give additional evidence concerning geographical distribution, and from that point of view especially this report will be welcomed. Emphasis is placed on the cosmopolitan distribution of certain species, at one time considered bipolar, but actually found in temperate and tropical seas of both hemispheres. It is also remarked that temperature seems to have much more influence on polychaetes than does pressure.

Rust Fungi of the Philippines

MANY new species are described in the second paper, by J. C. Arthur and George B. Cummins, on Philippine rust fungi in the Clemens collection, made in 1923-26 (*Philippine J. Sci.*, 61, No. 4, 463-488; Dec. 1936). *Crossospora fici*, as its specific name suggests, attacks *Ficus variegatus*; *Pucciniosira clemensiae* parasitizes a species of *Berberis*; *Gerwasia asciculata* occurs on *Rubus* sp., whilst *Uredo derridicola* forms pustules upon the insecticidal *Derris* plant. *Sphaerophragmidium irregulare*, *Ravenelia laevioidea*, *Spumula clemensiae*, many species of the genus *Uredo*, *Endophyllum enasculatum*, *Puccinia plectranthella*, *P. hemigraphidis*, *Aecidium manilense* and *A. dapsile* add to the imposing list of species new to science. Latin diagnoses make the descriptions of international value.

Tobacco Mosaic Protein

Two papers recently available (*Proc. Amer. Phil. Soc.*, 77, No. 4, April 22, 1937) summarize the fundamental work on virus proteins carried out at the Rockefeller Institute for Medical Research. Dr. W. M. Stanley gives evidence to justify the conclusion that a protein of unusually high molecular weight, obtained by him in crystalline form, is actually tobacco mosaic virus. The crystalline protein prepared from such different hosts as tomato and phlox, has the same chemical composition, isoelectric point, optical rotation and biological activity. Normal plant protein has a much lower molecular weight, and has other properties different from the virus protein. Crystals of the prepared material are needle-shaped, 0.02-0.03 mm. long, and give a regular crystalline pattern on X-ray analysis. Dr. Stanley's paper is highly informative, and supplies a succinct digest of the most recent work on this complex subject. Dr. Ralph W. G. Wyckoff describes "The Ultracentrifugal Study of Virus Proteins" in the same journal (pp. 455-462). He gives particulars of an air ultracentrifuge inspired by the original apparatus of Svedberg, with which he has demonstrated that the virus protein has a molecular weight of approximately 17,000,000. The apparatus can also be used to test whether the virus is one molecular species, or a family of related proteins, and can be employed to purify a virus extract, without chemical treatment, with its ultimate loss of strength. The delicacy of this method should make it possible to study less sturdy viruses than tobacco mosaic, and should open a new avenue of investigation.

Map of Ellsworth Trans-Antarctic Flight

THE material for a map of the Ellsworth trans-Antarctic flight of 1935 has been assembled by Mr. W. L. G. Joerg and Mr. O. M. Millar in the *Geographical Review* of July. The data consisted of sixty-six photographs taken during the flight and certain related photographs taken by Wilkins during his flight in 1928. Although much of the map is tentative, certain important conclusions emerge. Stefansson Strait of Wilkins disappears, and the peninsular character of Graham Land is re-established. Of equal interest is the narrow strip of shelf-ice lying on the south-western side of Graham Land and separating it from an enlarged Alexander Land or Island. This was crossed at an altitude of 3,050 metres and photographs were taken especially of the Alexander Land side. This strait was more thoroughly explored later by Mr. J. Rymill and found to be at

least 200 miles long. The Graham Land side was found to be mainly eruptive rocks, and the Alexander Land side fossiliferous stratified rocks. The two sides, contrasted in the photographs, probably represent the meeting of the plateau and Andean structures of Antarctica. Farther along the track various mountain peaks were seen, notably the Sentinel Range (lat. 77° 15' S., long. 88° W.) and another too far distant to photograph or even to place accurately, in about lat. 78°-80° S. and long. 85°-90° W. Nearer the Ross Sea the high ice plateau seems to be unbroken by range or nunatak. The maps are on varying scales and bring out these and other features clearly.

Effect of Obstacles on Sunshine Records

THE ideal to be aimed at in the placing of a recorder for the measurement of the duration of sunshine is a position where the sun is never obstructed when at a sufficient height above the horizon for a record to be obtained. For the standard instrument used in Great Britain—the Campbell-Stokes recorder—which focuses the sun's rays on a card and produces a burn when those rays are strong enough—it has been found that practically no record is obtained until the elevation of the sun exceeds 3°. The task of finding a position quite free from obstacles of greater elevation than 3° over those portions of the horizon, roughly from north-east to south-east, and from south-west to north-west, above which the sun passes during some part of the year at less than 3° elevation, is in many places an impossible one, consequently some information is desirable about the amount of loss resulting from obstruction, and this has been supplied by E. G. Hilham in "The Effects of Obstacles on Sunshine Records" (*Prof. Note 76. (M.O. 336p.)* London: H.M. Stationery Office. 4d. net.). The problem cannot be solved simply by calculating the length of time during which the sun is obstructed and comparing that with the total time during which it is above 3°, because there is a decided falling off in the frequency of recordable sunshine as the sun's elevation diminishes, due to haze, atmospheric absorption, varying cloud perspective, and other factors. If, however, the average percentage of the day's sunshine recorded when the sun's elevation is below various values in places free from obstruction is obtained, it is then possible to find the average percentage losses for obstruction of those values at places that have such obstructions. This is done up to 12° elevation, and it is shown that the percentage loss for a given altitude of obstruction is less in summer than in winter and less in the south of England than in Scotland. It is cheering to find that in general the percentage loss is much smaller than might have been expected; for example, in the summer half of the year, obstacles of 6° cause on an average little more than 1 per cent loss even if they extend laterally over the whole of the region occupied by the sun when its elevation is less than 6°.

Nature of Calomel Vapour

CONSIDERABLE interest has been taken in the nature of calomel vapour as deduced from vapour density measurements, that is, whether calomel is HgCl or Hg_2Cl_2 , since this is connected with the problem of the molecular complexity of mercurous salts. Earlier measurements corresponded with HgCl . Odling, in 1864, observed that a piece of gold leaf is amalgamated in calomel vapour and he concluded that the vapour is dissociated to some extent at least

into Hg and HgCl_2 , and this was confirmed by others. Smith and Menzies in 1910 showed that at 400° dissociation was complete in the sense of the equation $2\text{HgCl} = \text{Hg} + \text{HgCl}_2$. Since the mean molecular weight still corresponds with the formula HgCl , this is in agreement with previous work. H. B. Baker in 1900, however, had reported that when calomel was dried for three weeks in the dark with phosphorus pentoxide its vapour density at 400° corresponds with Hg_2Cl_2 . F. T. Gucker, jun., and R. H. Munch (*J. Amer. Chem. Soc.*, 59, 1275; 1937) have now reinvestigated the matter by measuring the absorption of the resonance line 2537 Å. by calomel vapour. From 450° to 100° the results indicate complete dissociation of the vapour, in accordance with Smith and Menzies' results, in the case of undried calomel. The vapour of carefully dried calomel shows the presence of mercury only at temperatures from 400° to 250° but not below. Calomel sublimed in a vacuum at 200° and condensed on a target cooled with liquid air shows no trace of mercury, whilst the condensate from a mixture of mercury and excess of mercuric chloride, sublimed in the same way, showed mercury in the deposit. The vapour of carefully dried calomel also showed general absorption in the ultra-violet, which the undried calomel does not show. The results of vapour density measurements of carefully dried calomel at 375° – 425° , however, corresponded with HgCl (or $\text{Hg} + \text{HgCl}_2$) and not with Hg_2Cl_2 , as found by Baker.

Production of Artificial Radioactive Elements

INTERESTING work on the production of artificially radioactive elements by bombarding lithium and magnesium with α -rays of 8 cm. range from thorium-C' is reported by A. Eckardt (*Ann. Phys.*, [v], 29, 497; 1937). No radioactive elements could be detected by means of a Geiger counter when lithium was bombarded. Nuclei which might possibly have been formed are ${}^8\text{Be}$ and ${}^8\text{B}$ [${}^7\text{Li} + {}^1\text{He} \rightarrow {}^8\text{B} + {}^1\text{n}$; ${}^7\text{Li} + {}^1\text{He} \rightarrow {}^8\text{Be} + {}^1\text{H}$]; but ${}^8\text{Be}$ is shown to be a stable nucleus. The stability of ${}^8\text{B}$ remains an open question, since its mass had not been determined when these experiments were carried out. Three possible radioactive nuclei, ${}^{28}\text{Si}$, ${}^{28}\text{Al}$ and ${}^{27}\text{Al}$, could be obtained from magnesium, of which the first two were detected. Their half-life periods are 7.6 min. and 2.2 min., respectively.

Adsorption of Gases and Vapours on Activated Charcoal

A CONTRIBUTION to our knowledge of adsorption and the formation of surface compounds is made in a note by R. Juza and R. Langheim (*Naturwiss.*, 25, 522; 1937). The adsorption of gases and vapours on activated charcoal was investigated, particularly from the point of view of changes in the magnetic properties of the adsorbed substances. The paramagnetism of oxygen disappears when the gas is adsorbed at room temperature on activated charcoal. This probably indicates the formation of surface compounds between the charcoal and oxygen, which, like carbon monoxide and carbon dioxide, are not paramagnetic. In the case of the adsorption of benzene vapour, the paramagnetism of the system is less than that of the two substances taken separately and added together. Similar results are found for bromine and iodine. If the magnetism of the charcoal is assumed to be unaltered, there is a decrease in the diamagnetic susceptibility of benzene, whilst bromine and iodine become paramagnetic on adsorption. The paramagnetism in the case of bromine and iodine

may indicate a splitting of the molecules into atoms under the action of surface forces, though another explanation is that the diamagnetism of the charcoal does not remain constant, but is decreased owing to the introduction of the adsorbed substance between the lattice planes of the graphite.

Astronomical Work at the Hamburg Observatory

IN the yearly report for 1936 by Dr. Schorr, director of the Hamburg Observatory at Bergedorf, it is stated that the 60-cm. refractor has been used for the photography of open star clusters, for spectrograms of Nova Lacerta 1936 and for the spectra of variable stars. Vol. 2 of a *Durchmusterung* of stellar spectra is complete, and vol. 3 is in course of preparation. A very useful catalogue of proper motions (*Bergedorfer Eigenbewegungs-Lexikon*, 1 and 2) has been distributed. Two specimen plates taken with the Schmidt reflector and correcting lens are reproduced. These plates show the "North America" nebula in Cygnus and the Great Andromeda nebula. The diameter of the field is 8° , and the images on the edge of the field show, in the reproduction, no trace of elongation. An investigation has been made of the astrograph telescope and measuring machine (sources of error, corrections, methods of reduction, etc.) with the view of using this instrument in taking part in the re-observation by photography with wide-angle lenses, of the zones of the *Astronomische Gesellschaft* Catalogue, which was originally based on meridian observations centred around 1880. The work of deriving accurate star places by photography with lenses covering a field of $5^\circ \times 5^\circ$ or greater was initiated, as is well known, by Dr. Schlosinger of the Yale Observatory.

Red Shifts and the Distribution of the Nebulae

IN a paper under this title (*Mon. Not. Roy. Astro. Soc.*, 97, May 7, 1937), Dr. Edwin Hubble considers the possible interpretation of red shifts as Doppler effects or otherwise. The subject has been treated in his recent work, "The Realm of the Nebulae", and the present paper deals more fully with the problem. In the former work he points out that if red-shifts are simply velocity-shifts, the correction to magnitude is $4\Delta\lambda/\lambda$, but if they are not it is $3\Delta\lambda/\lambda$, and as the relation derived from observation is $2.7\Delta\lambda/\lambda$, red-shifts are not velocity-shifts, unless some vital factor in the investigation had been ignored. The paper considers some of the criticisms of Eddington and McVittie. Eddington showed that in certain equations used by Hubble the possible effects of dispersion in the absolute magnitudes of nebulae had been neglected. Nevertheless, Eddington himself, after investigating the effects of dispersion, finds that the necessary corrections are of no importance. Hubble is of opinion that the observational data, when weighted in favour of the theory of red-shifts being due to an expanding universe, "still fall short of expectations". McVittie's numerical errors in some previous calculations have been corrected; but, as Hubble points out, the revised figures do not affect the argument in the present paper. In a homogeneous, expanding universe, when corrections are applied for the dimming effects of red-shifts, a negative curvature would introduce an apparent thinning out of the nebular distribution. As observation shows an apparently increasing distribution density, a negative curvature can be adopted only if we discard the theory of homogeneity or expansion.

Road Design and Road Safety

THE causation of road accidents and the measures which can be devised for their prevention are subjects of close study all over the world, but despite all the efforts which have been made, the fact has to be faced that in Great Britain, during the past ten years, a daily average of nineteen persons have lost their lives on the roads. This gives emphasis to the importance of a paper published, with the discussion to which it gave rise, in the *Journal of the Institution of Civil Engineers* (December, 1936), entitled "Road Design and Road Safety", and presented by Mr. Frederick C. Cook, chief technical adviser to the Ministry of Transport.

A lengthy examination of the statistics of the problem was made. As was suggested in the discussion, it is to be regretted that the records and investigations are confined to fatal accidents, as the fuller information obtainable in the other and more numerous cases might be expected to shed more light on causation. From these figures, the outstanding facts are that in 1935 the number of persons killed on the roads in Great Britain was 6,477, of whom 3,079, or forty-eight per cent, were pedestrians, and that the total number of vehicles involved was 8,730, of which the largest number in any one class, 2,513, or twenty-nine per cent, refers to private cars. On referring the figures either to a basis of 100,000 vehicles licensed in each class or to each 100,000 estimated vehicle-miles, the author shows the private car to be the least responsible, public conveyances being most culpable on the first basis and motor-cycles on the second. Examination of the published official figures reveals that in view of the complexity of the problem and the number of factors involved, they are inadequate to lead to reliable conclusions. For example, it is indicated that fully half the fatal accidents occurred on straight roads; yet here, where it might be that there were the elements of a clear case to decide as between road, car and driver, no analysis is given.

Going on to deal with the design of roads, the author considers and explains the influence of speed, desirable widths of carriage-ways, segregation of different classes of traffic and provision of dual ways, service roads, cycle tracks and footpaths, and their relation to traffic conditions. Such details of construction as the radius of curves, super-elevation, visibility, gradient and crossfall or camber are discussed and suitable minimum or maximum values recommended. In relation to the lay-out of road intersections, the author discusses the relative merits of a traffic signal installation, a roundabout, and a fly-over junction, and, of the last, illustrations were given both of a simple type and of one of the clover-leaf pattern.

With the view of obtaining a satisfactory road surface, testing of roads and materials and research are being continuously carried on, and it is hoped that asphaltic and bituminous coverings will be devised capable of maintaining non-skid properties for many years. Among the conclusions reached by the author, the most prominent are that the overwhelming majority of accidents are due to the personal element, that the main contributing cause is the simultaneous use of the road by motor vehicles, horse transport, pedal cyclists and pedestrians, and

that, as the mechanically propelled vehicle is the most destructive agent, the most effective safeguard is the provision of special ways for its exclusive use.

Also appearing in the same volume is an abridged report of a paper—"A Study of the Underground Road Crossings of Paris"—contributed by M. Gaston Bardot, in which he gives particulars of the subways built when the fortification belt of 1814 was converted into a circular boulevard. Some unexpected problems were encountered in these, notably owing to the dazzling glare reflected by the glazed stoneware lining from ventilation apertures. In one subway the electric lighting is controlled by photo-electric cells, so that the internal intensity is synchronized with that outside. Consideration of the varying degrees of visibility to which the eye of the driver has to be adapted led to the arrangement of zones of graduated lighting in lengths of sixteen yards, and while incandescent lamps had been employed in some cases, the monochromatic character of the sodium light was found to make it more easy to regulate.

In Road Research Bulletin No. 1 (H.M. Stationery Office, 1936. 9d. net), G. Bird and W. J. O. Scott describe the construction and operation of a machine for accurately comparing the 'slipperiness' of surfaces. This has been developed at the Road Research Laboratory of the Department of Scientific and Industrial Research, and consists of a motor-cycle and side-car in which the wheel of the latter, by being set at an angle to the direction of travel, introduces a skid component into its motion relative to the road. Dynamometers are carried which record the transverse and vertical forces on the wheel, the ratio of these giving a 'sideway force co-efficient' analogous to 'co-efficient of friction', by which the non-skid properties of road surfaces can be compared. The technique of testing by means of the machine is explained and typical results quoted. The apparatus has been in use for a number of years, and having been brought to a sufficiently high degree of development is recommended for use by road engineers or surveyors to measure and compare for themselves the frictional properties of the road surfaces for which they are responsible.

Road Research Technical Paper No. 1, by the same authors (H.M. Stationery Office, 1936. 1s. 6d. net), the first of a series of studies in road friction, summarizes the results of a large number of measurements of resistance to skidding, made under varying climatic conditions and at different speeds on roads of several types, by means of the machine previously referred to. The main facts which emerge from these tests are: dry, clean road surfaces, free from loose material, give a high coefficient at all speeds and may be regarded as non-skid; on wet surfaces the figure decreases as the speed increases and in most cases is subject to seasonal variation, being higher in winter than in summer; in a dry-wet-dry cycle, the co-efficient decreases rapidly to a minimum, increases slowly to a fairly constant value until drying commences, when it begins to rise to the normal dry surface value. It is also shown that, notwithstanding greater first cost, improved results and ultimate economy can be obtained from close attention to technique in construction of road surfaces in the light of the information derived from these tests.

Agricultural Meteorology in India

THE progress of agricultural meteorology in India is outlined in the latest annual report of the Agricultural Meteorology Branch of the India Meteorological Department, which covers the third year of that branch, ending Aug. 21, 1935. In the Experimental Section, a diagram is shown in which is plotted for three different levels the march of temperature throughout the 24 hours in the stem of sugarcane and in the air at the same levels, the observations having been made in a small plot of sugarcane at Poona with the aid of a portable thermo-couple set specially designed for obtaining plant temperatures. This set was described in the previous year's report. It is seen that the sugarcane is cooler than the air during the day, but warmer at night. Further work on portable percolation gauges and evaporimeters is described in the same section.

Another interesting diagram relates to the micro-climates of growing crops. Graphs are shown of the variation of dry bulb temperature and of vapour pressure at various heights up to 6 feet within the crops and in the open air during the hottest part of a typical fine afternoon in October, that is, in the clear season. The observed differences are greatest at the level of the ground, and in the case of the vapour pressure become small at a height of 6 feet. A large amount of experimental work was also done on the behaviour of various soils with respect to evaporation during the day and absorption during

the night. It was found that the black cotton soils have the greatest diurnal variation of moisture content and the alluvial soils the least.

Radiation received a large share of attention, especially the nocturnal radiation from the surface of the earth and its relationship with the water content of the atmosphere. It is claimed that this study of the exchanges of radiation between the ground and various layers of the atmosphere explained why the temperature was found to decrease with height in the first few centimetres above the ground and then to increase.

In addition to these nocturnal studies, measurements were made with a pyrliometer at Poona at fixed times on clear days, and every hour on representative days during each month, of the intensity of direct solar radiation and the distribution of energy in different parts of the spectrum; a self-registering Moll solarigraph was also maintained in action during a large part of the year. Another solarigraph was set up at Shahjahanpur, and it is intended to install a third at Lyallpur, with the view of discussing eventually the seasonal variation of the total radiation of sun and sky in different parts of India.

A striking feature of the work in nearly all the branches of agricultural meteorology described in this report has been the amount carried out voluntarily by research students, some of whom were working for the M.Sc. degree.

Game Sanctuaries or National Parks

THE subject of the preservation of the wild fauna of the world, especially in those parts where for a variety of reasons there exists grave danger that interesting species may under the actions of man be exterminated, has been before the public on several occasions lately. The well-known national parks in the United States and Canada are often quoted as examples to be followed elsewhere. It is true that on a far smaller scale both national park and fauna (and flora) sanctuaries can be formed—even in the small island of Great Britain; and evidence shows that steps are being taken to give effect to so desirable an object.

It appears to be a curious fact that in the British Empire such suggestions have met with little response until lately, either in Asia or Africa. That position is now also being rectified in some degree. In India the subject of fauna preserves has been ventilated for a number of years. In fact, fauna sanctuaries have been in existence since early in the present century.

The commencement was made in Assam, for the protection of rhinoceros, bison, buffalo and elephant; though the latter has been under protective laws in British India for decades. About 1908-10 a fauna sanctuary was formed, under the auspices of Sir John Hewett, Lieutenant-Governor of the United Provinces, in the great sal forests at the foot of the

Himalaya in these provinces. At the time there was a considerable divergence of opinion as to whether the sanctuary should be permanent or only for so many years, after which it would be opened to shooting and another area closed.

As a result of these early attempts and the more modern ideas attached to a national park which have been given ventilation in the Press of late years, in the spring of 1934 Lord Hailey, at the time Governor of the United Provinces, suggested that the Forest Department should make proposals for the creation of a game sanctuary or national park on the lines recommended by the International Conference of 1933, that is, a national park to be created by legislative authority. The account of this departure, and the formation of the Park to which the name of the Governor, Lord Hailey, was given, is detailed by E. A. Smythies ("The Hailey National Park". *Indian Forester*, 2, 467). The area selected for the park is in the famous and beautiful Patli Dun and the hill forests to the south of it in the Ramganga Valley, situated at the foot of and in the foothills of the Himalaya somewhat to the east of the River Ganges. The total area selected is about 125 square miles.

A Bill, the first of its type in India, was drafted. The United Provinces National Parks Act, 1935, was finally passed by the Legislative Council and

received the assent of both Governor and Governor-General. Its provisions are very wide. For example, "animal" is defined as "any mammal, reptile (excluding snakes, except python) or bird"; and it is an offence "to kill, injure, capture, or disturb any animal or to take or destroy any egg or nest of any bird". Permits have to be obtained by anyone wishing to enter or reside in the Park. Photography is permitted, but no flashlight apparatus may be taken in. Roads are projected in

order to make this area freely accessible to the public.

Since the Patli Dun has long been famous for its tigers and leopards, it will be of interest to note any changes which may take place in their habits and attitude towards man, when the Park, which to date has seen little save the forest officer, timber contractor and hot weather shooting and fishing parties, becomes frequented by the holiday-maker and tourist.

Association of Special Libraries and Information Bureaux

FOURTEENTH ANNUAL CONFERENCE AT CAMBRIDGE.

THE fourteenth Annual Conference of the Association of Special Libraries and Information Bureaux was held at Gonville and Caius College, Cambridge, on September 24-27. The programme of the Conference covered a wide field and merited a considerably larger attendance, although that was well up to the average of recent years. The address of the president-elect, Sir Harry Lindsay, on the Friday evening on "The Interrelation between Science, Agriculture and Industry" gave an excellent start to the Conference. Sir Harry stressed not merely the way in which the prosperity of agriculture and of industry were really connected, but also the importance of understanding the real differences between the objectives and methods of the agriculturist and the industrialist, with the view of developing a long-range policy which would eliminate conflict.

Pointing out that the manufacturer was better able than the agriculturist to adjust his output and methods quickly, so as either to benefit by increased demands or to shelter himself against reductions of demand, Sir Harry emphasized that the lesser susceptibility of agriculture to scientific control was due essentially to the fact that the agriculturist was dealing with Nature and the growth of living organisms, not with inorganic or dead matter. In addition, while the Great War gave a great impetus to scientific discovery and to the application of scientific method, it had also a disintegrating effect on the whole structure of industry and commerce, particularly in the destruction of credit. Although the ultimate effects of scientific discovery were beneficial, their immediate effects on business relations were disturbing. As an example, Sir Harry referred to the use made by the business man of modern means of obtaining knowledge of events to lay in or unload his stocks, and asserted his belief that the huge stocks of primary products which were a feature of post-War commerce had always existed, but in pre-War days were so spread that they were invisible and their effect unfelt. This throwing back of stocks on to the primary producer was another factor in the post-War years of disparity between the prices of agricultural produce and those of manufactured goods. Quality was another factor, and in competition between natural and synthetic products, the natural was usually the better although liable to fail in its resistance to standardization or to respond to increased demands. As regards foodstuffs the natural products still held their own. Despite the general cheapening of production and the higher

standard of living, the cost of transport remained high and the question should be faced whether profit-making was the soundest principle on which to build our economic policy. Sir Harry considered that we were at present evolving a new technique of conscious control of economic life; long-range and not short-range solutions of our economic problems were required, and we were advancing to a new technique whereby instinct was supplanted by conscious constructive action.

A symposium on "Newspaper Indexing", at which Capt. A. C. Taylor presided, was opened by a paper by Miss Marie-Anne E. Walker of the *New York Times*, read by Dr. R. H. Hutton, which described the efforts made in this field in the United States, particularly the *New York Times Index* and the indexing project initiated under the New Deal Administration. Mr. J. J. Eaton of the *Yorkshire Post* approached the subject from a different angle, giving an impressive picture of the range of information which a newspaper library was expected to supply whether for the internal staff of the paper or for its readers. In describing the actual indexing system used, Mr. Eaton referred to the possibilities of using micro-photography for this work which they were now exploring. The discussion and papers alike stressed the value of the newspaper as a source of contemporary history, and the increasing reference to scientific matters in the Press renders the subject of some immediate interest to scientific workers. Already it not infrequently happens that not merely the earliest but sometimes the only report of a scientific meeting or discussion appears in the daily Press.

At the next session of the Conference, Dr. S. P. Turin presented a paper on "Scientific and Technical Research in Soviet Russia", in which he emphasized the need for establishing some system of regular research work on Russian subjects if much valuable work was not to be lost. Already constant watch on publications was required to obtain really exhaustive knowledge of any subject of research. Dr. Turin gave a list of various research institutes as well as an outline of the work of three associated with the oldest universities, and some details of science and special libraries in Russia. His plea for a central research body was accompanied by reference to conditions which must be fulfilled in establishing regular contact with Russian institutions. In the first place it was necessary to emphasize our *bona fide* interest in scientific and technical research and to show that we did not desire to utilize Soviet inven-

tions and patents to undermine the Soviet system, but that our aim was international co-operation in the interests of science. Intercourse must be established through the official channels, although direct intercourse with scientific workers on the spot was not excluded. In summarizing the discussion, Mr. J. G. Crowther, who presided, pointed out that it was clear that the present position was not entirely satisfactory and that real difficulties were being experienced in obtaining Russian scientific and technical publications.

A somewhat disappointing discussion on Saturday afternoon, over which Mr. W. MacNab presided, in the absence of Mr. T. F. Burton, dealt with the extent to which the present system of abstracting services covered scientific periodical literature. In his paper opening this discussion, Dr. S. C. Bradford, without adducing anything essentially new, called attention to the duplication which persisted under the present system and also to the danger of papers in an out-of-the-way language or in border-line sciences being missed. His conclusion that at present nearly two thirds of the worth-while scientific and technical papers are published only to be buried out of reach on the library shelves was obviously received with a good deal of scepticism by the Conference, and in spite of his insistence on the need for recognizing the essential unity of science and for much closer co-operation, the discussion led to no concrete proposals, nor was the question of organizing abstracting and indexing services by divisions of industry rather than by branches of science even raised.

The report presented to the annual meeting of the Association referred to an actual excess of expenditure over income during the year of £69, partly due to increased office expenditure and staff. While increased sales of publications are likely to rectify this position, a considerable increase in membership is required if the Association is to take up many projects which are in need of its attention. The report also refers to the progress of the Book List, the re-organization of the Panel of Expert Translators, the preparation for a new edition of the ASLIB Directory and the attention given to the indexing of early newspapers.

Lieut.-Colonel E. T. Crutchley's address on "The Public Relations Officer" on Saturday, which described the work of the Public Relations Officer in the Post Office, provoked an interesting discussion which largely centred on the success of this experiment in applied psychology by the Post Office in explaining its work to the public and recording its activities. The scheme was also highly suggestive for all those who are interested in the establishment of good relations between management and staff and customers in industrial organizations and commercial undertakings, or in large Government departments or public utility companies. Lieut.-Colonel Crutchley showed convincingly the opportunities for applied science which exist in this field.

An excellent paper on the principles and practice of technical translating was contributed by Dr. J. E. Holmstrom at a session on Sunday morning over which Mr. J. G. Pearce presided. Dr. Holmstrom laid considerable stress on the importance of lucidity and style in translation work and referred to the advantages of the dictaphone system in saving the time of translators. Dr. Holmstrom gave details of a number of useful dictionaries, on the merits of which Mr. H. H. Johnson of *Engineering* and other speakers in the discussion commented.

The most interesting session of the Conference was the second session on Sunday morning which, as Prof. R. S. Hatton pointed out in his introductory paper, was almost the first opportunity in Great Britain for librarians to review the development and prospects of micro-photography. The high capital cost of the mechanized equipment required was compensated by the large reduction in the running costs. The Draeger camera, the Folmer Graflex Corporation camera, the Recordak camera and the Saint Ret-Seidell camera all aimed at labour- and time-saving by mechanized control of exposure and advancing the film, by book-holding devices, etc., and for some of this apparatus an output of 5,000 exposures or 10,000 pages a day was claimed. The spools of films could be selected for either small quantities such as 36 exposures on a 5 ft. length or up to 1,000 ft. of film. The British Museum was already making micro-films for an American project to secure for subscribing American libraries copies of all English books published before 1550. It was estimated that there were 4,000 separate books to be copied and the cost of copying the 400,000 pages works out at about a farthing a page. Such films are available for reading in one of the projection or enlarging machines constructed for the purpose or can be used to obtain a photo-enlargement on paper. The use of micro-film for newspaper record purposes in the United States is already being extensively tried, and its large saving in space—estimated at more than 98 per cent of that required for the bound volumes—renders it highly attractive for other libraries. Dr. Hutton stressed the durability and non-inflammability of the film used and referred to its possibilities in regard to library union catalogues, bank cheques, census purposes, and the like as well as to others in conjunction with the Kolleritt system or photo-electric cells for selecting material required.

A paper by Mr. Watson Davis, which in the author's absence was read by Prof. Hutton, referred to developments in the use of micro-film in the United States, particularly those sponsored by the Documentation Division of Science Service to assist the publication of scientific papers and the Bibliofilm Service in the Library of the U.S. Department of Agriculture, which have now both been taken over by the American Documentation Institute. Mr. L. A. Sayce described his experience of micro-film work at Armstrong College, Newcastle-on-Tyne, and Mr. K. Stuart-Smith gave some account of work in this field for which Kodak Ltd. had been responsible. The discussion left a distinct impression on the mind that the library of the future may present an interesting resemblance to the library of the ancient world with its rolls of film in place of the rolls of manuscript.

At the concluding session on Sunday evening, when Mr. Will Spens, Master of Corpus Christi College, presided, Lieut.-Colonel C. Bridge described the work of the British Council, in which he insisted on the need for further private support if the work initiated was to be carried on effectively. Besides helping to establish lectureships and professorships at foreign universities and sending distinguished lectures abroad, to build up libraries of British books abroad and to increase the circulation of British periodicals, the Council was now dealing with broadcasting and films. Colonel Bridge emphasized the endeavour of the Council to avoid counter propaganda in its work but rather to interpret the national point of view and to make known the full wealth of our civilization.

Recent Excavations in Roman Britain

COLONEL C. D. DREW, who is in charge of the excavation of the Roman house-site in Colliton Park, Dorchester (see *NATURE*, Aug. 21, p. 311), reports the interesting and unusual discovery of the leg of a Roman chair, made of Kimmeridge shale. It was found beneath the damaged floor of the heated room, of which the tessellated pavement, as previously reported, had collapsed. It was found that stonework supporting the floor had sunk where the filling of a pit had proved less compact than the surrounding chalk. The chair leg was found deep down in the filling of the pit, which was of considerable depth. It is richly carved with the head of an open-mouthed animal, and the foot terminates in a lion's claw. It is in an excellent state of preservation, but requires skilled treatment to prevent flaking, before it can be placed on exhibition in the Dorchester Museum. As articles of Roman furniture are of rare occurrence in Britain, the find is of considerable interest. Among other recent finds on this site are thirty bronze coins of the fourth century A.D. from a trial trench. The excavation committee has approached the County Council with the view of securing the preservation of the remains of this Roman house, and the matter is now under the consideration of a sub-committee of the Council.

A large and important collection of Roman relics has been discovered by the excavation section of the Thoroton Society of Nottingham on the corporation housing estate at Broxtowe in the old part of the city. According to report (*The Times*, Oct. 4), the finds include a grave containing bones and Roman coins, brooches, a silver spoon, rings, knives and dice of wood. Among the broken pottery is some highly glazed Samian ware of the first century, decorated with hares and hounds. A portion of the Roman road was uncovered and a quantity of oyster shells was found.

At Lincoln the demolition of an eighteenth century house abutting on the Newport Arch, the only remaining Roman arch in Britain which spans a public road, has brought to light evidence which reveals that the arch in its original form has a postern gate on either side. There is at present on the eastern side a postern gate which is used by foot passengers; but when the western side of the arch was laid bare by the recent work of demolition, the beginning of the spring of the second postern gate was disclosed. It corresponds with the gateway on the eastern side. The arch was scheduled as an ancient monument in 1924; and according to a report in *The Times* of October 4, it is hoped to modify the rebuilding scheme in such a manner as to allow for the restoration of the postern gate on the west side.

Excavation on what is supposed to be the site of the Roman town of Sulloniaca at Brockley Hill, Middlesex, two miles north of Edgware on the east side of Watling Street, points to the possibility that it may have been originally a native town or *oppidum*, of which the population shifted after the conquest, attracted by the facilities for traffic offered by this trunk road. The investigation is being carried out by the London and Middlesex Archaeological Society with the co-operation of the Stanmore and Edgware Historical Society under the direction of Mr. F. Cottrill, local secretary of the Society of Antiquaries (*The Times*, Oct. 1). The site lies at the east end of a gravel ridge, which rises to a height of five hundred feet.

The arrangement of banks and ridges at Brookley Hill recalls the site of Prae Wood at St. Albans, excavated by Dr. R. E. Mortimer Wheeler. A Belgic potsherd has been found in one of the ditches. A trench dug near the east side of the road gives a section of two depressions, twenty feet and nine feet wide respectively, in the natural clay. The filling of these depressions produced pottery of common late first and early second century types in considerable quantity, the common 'screw-neck' flagon predominating. Some sherds showed signs of over-firing, while some almost complete pots had been thrown away on account of flaws in manufacturing. This, with the evidence of masses of baked clay, brick and tile 'wasters', points to the existence here of a roadside industrial settlement for the making of bricks and pottery. Another trench revealed a Roman occupation layer of the first century, which had been partly removed by seventeenth century and early eighteenth century builders. Exploration farther away from the road produced no evidence of occupation beyond a small Belgic pit. No traces of a Roman building have been found. Evidently the kilns had been placed at the east end of the town to avoid the fumes which would be carried by the prevailing south-west wind.

University Events

GLASGOW.—Dr. Paul Baeschig has been appointed lecturer in embryology in the Department of Anatomy, and Dr. H. Ellis C. Wilson lecturer in pathological biochemistry at the Royal Hospital for Sick Children.

LONDON.—The following announcements have been made from University College: Prof. S. Sugden, formerly of Birbeck College, succeeds Prof. F. G. Donnan in the chair of chemistry; Prof. C. K. Ingold becomes director of the Chemistry Laboratories.

The Department of Geography has been moved to new, freshly equipped quarters in Foster Court (the block of buildings on the south side of the College, acquired in 1931).

The University has accepted the benefaction of the late Mrs. Florence Joy Weldon, of Oxford, who bequeathed her residuary estate upon trust for the foundation of a professorship of biometry for the higher statistical study of biological problems. The chair has been established at University College, the first holder being Prof. J. B. S. Haldane (see p. 612).

READING.—Dr. G. W. Scott Blair, of Rothamsted Experimental Station, has been appointed head of the Dairy Chemistry Department of the National Institute for Research in Dairying in succession to Captain J. Golding, who has retired.

ST. ANDREWS.—In connexion with the celebration of the quatercentenary of St. Mary's College on September 28 the honorary degree of LL.D. was conferred, among others, on the following: R. F. J. Fairlie, architect for the restoration of St. Salvator's Chapel, St. Andrews, and of the Scottish National Library; the Right Hon. Sir John Simon, Chancellor of the Exchequer; Prof. G. F. Stout, formerly professor of logic and metaphysics; and Sir Leonard Woolley, director of the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania to Mesopotamia.

Science News a Century Ago

Government Experimental Distillery

THE issue of *The Times* of October 12, 1837, gave an account from Government papers of the Government Experimental Distillery, by which it was anticipated several millions a year would be added to the revenue and illicit distillation be suppressed. "The extensive premises, formerly the Hope Brewery, in Brown's-lane, Spitalfields," said *The Times*, "having recently been fitted up as an experimental distillery upon a large scale, under the superintendence of Dr. Birkbeck, by order of the Lords of the Treasury, for the purpose of testing the efficiency of Mr. Rudkin's apparatus for taking the excise on spirits in process of distillation, several preparatory distillings have taken place during the last fortnight, and yesterday the distillery was set at full work. The experiment so far has been in the highest degree satisfactory and in the opinion of Dr. Birkbeck and other scientific men sufficiently conclusive as to the utility of the invention."

The instruments previously in use were the saccharometer and thermometer, but "the utter inefficiency of the saccharometer and the thermometer for the purposes for which they are used has long been well known", and it has been declared that "there is at present no security for the collection of any portion of the revenue, except in the conscientiousness of the distillers. . . . Government, chiefly through the medium of the Royal Society, has long applied itself to remedy this evil. About 70 years ago Lord George Cavendish carried out a series of laborious experiments for this purpose, which led to no results, and upon his failure the matter was committed to Sir Joseph Banks; but his labours were attended with no better success". According to Dr. Birkbeck, however, Mr. Rudkin has solved the great and important problem. "If his instrument eventually realises his professions . . . it will do away with all the inconveniences of the present system . . . as it registers the quantity, temperature and strength of every gallon of spirit as soon as produced, and before it comes under the control of the excise man and distiller."

Faraday's Diary

FARADAY'S Diary contained not only his notes on experiments but also his queries, references and reflections. Under the date October 14, 1837, he wrote:

"4048. Charge of clouds. How do they become electrified if there be no absolute charge?"

4049. No charge from breaking up sulphur or change of state.

4050. Nature of discharge through cracks in glass.

4051. Is Fischer's observation on variation of conductivity of platina sound or no, and if it is, what bearing will it have on thermo-electricity? Bib. Univ., 1831, xlii, 267.

4052. Matteucci—Expts. on Evaporation of water from soil as a source of Electricity. Bib. Univ., 1834, lvi, 328.

4053. Thermo-electricity. Is it possible Peltier's experiment (Bib. Univ., 1834, lvii, p. 181) can be true, i.e. that a thermo electric current produced such an effect elsewhere as to create an opposite current greater than the original?

4054. Electricity in motion penetrates bodies. Statical Electy. does not, but is superficial. The

reason of this is evident on the particle action theory without breaking in on a law or requiring a new one. Before the conduction took place and after the communication was completed, both insulating and conductive particles were polar—but one can equilibrate or discharge more than the other.

4055. Induction—Nobili has some general facts in very good relation to induction. Bib. Univ., 1835, lix, pp. 275."

Caverns in Brazil

THE October 1837 issue of the *Gentleman's Magazine* contains the following information: "Dr. Lund, the Danish traveller, now in Brazil, has discovered in the mountain chains between the Rio Francisco and the Rio das Velhas a great number of caverns; among which Sappa Nova de Maquiné, in the Sierra de Maquiné, is one of the most remarkable. The mountain consists of clay slate, flinty slate and limestone of the transition period, in which last is the cavern described; the total length of which from north to south is 1,440 feet, the height being from 30 to 40 feet, and the breadth from 50 to 60. It is separated by masses of stalactite into twelve divisions, of which only three were known before Dr. Lund explored them. The others, especially the innermost, were of such extraordinary beauty that his attendants fell on their knees and expressed the greatest astonishment."

"On the River Velhas, the banks of which the traveller afterwards traversed, the vegetation assumes a peculiar character. The inhabitants call the forests *catingas* (white forests). They form a thicket of thorny trees and bushes interwoven with parasitical plants of the same nature. The leaves fall in August, and from the beginning of September till the rainy season the *catingas* are as bare as European forests in winter. On this excursion Dr. Lund had an opportunity of examining nineteen caves, all of which confirmed his opinion of their geological formation. He has collected many remarkable particulars respecting the circumstances which must have taken place in a great inundation, as well as respecting its effects, and convinced himself by several indications, that its course in South America was from north to south."

German Scientific Association

"SOON after the meeting of the British Association at Liverpool," said the *Mechanics' Magazine* of October 14, 1837, "its German prototype the Society of 'Enquirers into Nature' (Naturforscher) held its fifteenth annual assembly at Prague. The object which seems to have attracted most attention this year was an apparatus for the production of powerful electric streams by means of steel magnets operating on a multiplying conductor. It was exhibited and explained by its inventor, M. von Ettingshausen, professor of physics in the High School at Vienna. This gentleman acknowledged that his apparatus bore some resemblance in principle to that invented for the same purpose by Mr. Clarke in London, and that it was by no means superior in power, but contended that the apparatus was the more simple and convenient of the two." It was agreed to hold the next meeting of the Society at Freiburg, in Baden, to afford an opportunity to Prof. Oken, the founder of the institution, "to be present at the operation of his own new apparatus, for the production of electric streams of science, from which he has been for ten years an unwilling absentee".

Societies and Academies

Paris

Academy of Sciences, August 2 (*C.R.*, 205, 301-344).

A. LACROIX: The reality of an eruption of the Soufrière of Saint-Vincent in 1718, from an observation made at Guadeloupe. In the records of the Royal Academy of Sciences for 1718 a letter has been found confirming an eruption at the island of Saint-Vincent, previously regarded as doubtful.

PAUL LANGEVIN: Sagnac's experiment. Criticisms of a recent note on this subject by A. Dufour and F. Prunier.

PIERRE LEJAY: The variations in the quantity of ozone contained in the atmosphere in the neighbourhood of Shanghai. An analysis of five years observations.

NIKOLA OBRECHKOFF: A theorem for the zeros of polynomials.

RAPHAËL SALEM: A generalization of Poisson's method of summation.

ROBERT CORDONNIER: The application of Verdet's law to solutions. The magnetic rotatory power of the ions.

JACQUES DUCLAUX and MIGUEL AMAT: Ultra-filters of carborundum. Carborundum powder has been separated by levitation into fractions of different sizes of grain, and from these, ultra-filters have been prepared capable of removing various colloidal suspensions, such as copper cobalticyanide, arsenic sulphide and ferric hydrate. The finest grain filters prepared fail to filter off Congo red.

MME. GERMAINE CHAUVENET and GABRIEL VALENSI: The velocity of oxidation of cobalt.

ANDRÉ MAMAN: Contribution to the study of the octanes. Ten isomeric octanes have been prepared and the temperatures determined at which carbon monoxide appears when the hydrocarbon mixed with oxygen is heated.

ANDRÉ DEBIERNE and LADISLAS GOLDSTEIN: New transformations produced at low temperatures (*frigad reactions*). It was shown in a previous note that certain gases, especially hydrogen and helium, in contact with carbon cooled in liquid nitrogen, gave rise to a large evolution of heat. In the experiments now described, the carbon has been replaced by other elements (beryllium, magnesium, aluminium, nickel, copper, sand) and the heat evolution noted. With beryllium and helium the evolution of heat is larger than with helium and carbon. Generally, the light elements give the most marked reaction. No radiations could be detected outside the apparatus, but it is suggested that the *frigad reactions* correspond to nuclear actions.

GEORGES PETIT: The mechanism of the attack by sulphuric acid on monomethylarsenic and dimethylarsenic acids.

RENÉ DUBREISAY and ALBERT SAINT-MAXEN: Researches on the basic lead acetates.

MAX MOUSSERON and ROBERT GRANGER: Some derivatives of the C_4 and C_6 1,2-cyclanediols.

LUCIEN DAUTREBANDE, PIERRE ANGENOT and EDMOND DUMOULIN: The study of esparto grass antiserol filters. The protection of the antiserol filters against moisture by a layer of dehydrating substance.

RAYMOND JACQUESSON: A type of crystalline texture observed in aluminium wires submitted to alternating torsion.

EDOUARD ROCH: The Visean of the Haut-Atlas to the east of Marrakech.

EMILE THELLIER: The disappearance of the permanent magnetization of baked earths by reheating in zero magnetic field.

MME. C. SOSA BOURDOUIL: Remarks on the composition of the pollen of some Ranunculaceae and on their systematic position. The nitrogen percentage in pollen is different in different botanical groups. Thus in the *Aquilegia* type the nitrogen in the pollen varies between 6.6 and 7.2 per cent; in the *Clematis* type, between 5.3 and 5.7 per cent; the *Ranunculus* type, between 4.2 and 4.9 per cent.

MARC MURAT: The vegetation of the western Sahara in Mauritania.

G. LAVIER: The cytology of the Protists of the genus *Plastocystis*.

Cape Town

Royal Society of South Africa, July 21.

A. J. H. GOODWIN: Archaeology of the Oakhurst Shelter, George. (6) Stratified deposits and contents. The stratified deposits, excluding grave infillings, etc., are here discussed. The deposits include Middle Stone Age, Smithfield B, Smithfield C, Normal Wilton and Developed Wilton. (7) Summary and conclusions.

H. ZWARENSTEIN: Gonadotropic activity of amphibian pituitary. Implantation of 8-20 mgm. of anterior pituitary tissue of *Xenopus laevis* in immature female mice caused opening of the vagina, enlargement of the ovaries with occasional haemorrhagic follicles (blood spots) and a two- to four-fold increase in uterine weight. Control implants of frog's brain, muscle, liver, kidney, spleen and ovary gave negative results.

R. H. SMITHERS: Notes on the stranding of a school of *Pseudorca crassidens* at Berg River mouth in December, 1936.

F. SEBBA and W. PUGH: Gallium. (4) The phosphates and arsenates of gallium. Gallium orthophosphate has been prepared by neutralizing a solution of a gallium salt in presence of a phosphate. The gallium is completely precipitated as a gelatinous phosphate. A crystalline variety has been prepared under pressure. Both forms are anhydrous. Gallium ortho-arsenate has been prepared in a similar way, and both gelatinous and crystalline forms have been obtained. The arsenate separates as the di-hydrate. A crystalline complex galli-arsenate has been prepared by using a large excess of arsenate in strongly alkaline solution under pressure.

August 18.

W. PUGH: Mercurous perchlorate as a volumetric reagent for chlorides and bromides. With bromophenol blue as absorption indicator, mercurous perchlorate gives an excellent colour change at the equivalent point. The results are accurate. It has the advantage over silver nitrate that it can be used in acid solutions.

P. W. LAIDLER: Pipes and smoking in South Africa: an account of the typology and distribution of pipes of clay, stone and bone in South Africa.

M. R. LEVYNS: The geographical distribution of plants in the western portion of the Little Karroo. The area discussed is bounded on the north by the Zwartberg and on the south by the Langeberg, and has an altitude a little under 2,000 feet. Numerous kopjes are dotted over the area. The flora consists largely of succulent plants and the vegetation as a whole is of a very open type. Four mountain ranges with altitudes in the neighbourhood of 5,000 feet occur as islands in the Karroo. Towards the summits of these isolated mountains the Cape flora gradually replaces the Karroo flora. This change may be correlated with an increase in rainfall.

J. C. MIDDLETON-SHAW: The teeth of South African fossil pigs (*Notochoerus Capensis* syn. *Meadowsi*) and their geological significance.

J. L. B. SMITH: An interesting post-larval stage of the "Galjoen".

Cracow

Polish Academy of Sciences and Letters, June 14.

TH. BANACHIEWICZ: The precision of an elliptical orbit determined from three observations.

S. KACZMARZ: The resolution of a system of linear equations by successive approximations.

K. KOZIEL: Some formulae relating to the ratios n_1 and n_2 of the areas of triangles.

MLLE. L. STANKIEWICZ: The arithmetical operations in the calculation of inverses according to the method of Banachiewicz.

S. PIOTROWSKI: A method of determining the orbital elements of double stars with eclipses.

S. PIENKOWSKI: The fluorescence of octahydro-fluorocyclene ($C_{18}H_{30}$).

S. MROZOWSKI: The influence of the presence of a gas and of the magnetic field on the degree of polarization of the fluorescence of iodine vapour.

A. JAGIELSKI: The dielectric polarization and viscosity of the chlornitrobenzenes in the liquid state.

MLLE. B. TWARDOWSKA: Contribution to the study of the fluorescence and adsorption of biacenaphthylidene ($C_{24}H_{18}$).

MLLE. Z. LEWKOWICZ: The influence of the wavelength of the exciting light on the relative yield of the fluorescence of benzene solutions of biacenaphthylidene ($C_{24}H_{18}$).

K. DZIEWONSKI and L. GIZLER: The synthesis of fluorocyclene ($C_{10}H_{16}$) and its transformations into other hydrocarbons.

W. BEDNARCZYK and L. GIZLER: The absorption of ultra-violet radiation by fluorocyclene and by hydrocarbon products of its transformations.

B. SKARZYNSKI: The absorption of ultra-violet radiation by ascorbic acid (vitamin C).

J. NOWAK: The age of the Magura grit in the region of Babia Góra.

MLLE. K. CISZEWSKA and M. KSIAZKIEWICZ: Comparison of the Wienerwald fleisch with that of the Carpathians.

F. ROGOZINSKI: (1) Contributions to the estimation of magnesium. (2) The gravimetric estimation of chlorophyll.

E. FACHLICH: Systematic studies on the Cochlearia of Poland and other congeneric European species.

L. KORZENIEWSKI: Biometric studies on the variation of the seeds of the Siberian cedar (*Pinus Cembra*).

W. JUSZCZYK: The distribution of the chromatophores in the skin of *Pelobates fuscus* and in that of flavistic specimens.

F. ROGOZINSKI: Carotenoids and chlorophyll in the digestion of the ruminant.

J. GALLERA: The development of the extra-neural ectoderm in birds.

ST. MARKOWSKI: Evolutionary cycle and biology of the nematode *Contracaecum aduncum*.

Rome

National Academy of the Lincei (*Atti*, 24, 493-530; 1936).

F. SEVERI: Supplements to the general theory of correspondences between algebraic varieties (1).

G. BARBA: Definite polynomials (2). Classes of definite polynomials obtained from some which are fixed in advance.

G. ARRIGHI: Mechanics of floats with internal cyclic motions.

L. SONA: Dynamic actions of a translo-circulatory current which invests an obstacle consisting of two crossed laminae.

P. CALOI: Hypocentral depths, with particular regard to the earthquakes of the Carnic Alps (June 8, 1934) and of Lake Constance (January 31, 1935).

G. LOLLI: Curves of alcoholæmia obtained by administering hydro-alcoholic drinks through a gastric and duodenal tube.

M. PITOTTI: Presence of a true subrenal capsule in *Selaci*.

S. RANZI: Endocrine glands, sexual maturity and gestation in *Selaci*.

Atti, 25, 3-71; 1937.

F. SEVERI: Supplements to the general theory of correspondences between algebraic varieties (2).

E. ALMANZI: Fundamental principle of classical mechanics.

G. CHECCHIA-RISPOLI: Preliminary observations on the Cenozoic series of the Apulian Apennines.

G. BARBA: Definite polynomials (3). Interpretations, properties and supplements.

R. CACCIOPOLI: Analytical character of the solutions of a class of problems of the calculus of variations.

M. HAIMOVICI: Surfaces which correspond through parallel tangent planes so as to conserve a Tchebycheff lattice.

E. MARTINELLI: Cauchy's formula for the analytical functions of two complex variables.

G. OBERTI: Wave propagation in imperfectly elastic systems.

G. PICCARDI: Molecular spectra and spectroscopic analysis (5). Detection of gadolinium.

C. SANDONNINI and N. BORGHELLO: Electrolysis of iodine monochloride in various solvents.

O. VERONA and G. BONAVENTURA: Influence exerted on the development of plants by the partial elimination of the reserves accompanying the embryo, and the probable presence in them of 'growth substances'.

E. CARANO: Memorial lecture on Pietro Romualdo Pirota.

L. CARNERA: Memorial lecture on Friedrich Küstner.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, October 11

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. Phyllis Tookey Kerridge: "The Physiology of Hearing and Speech" (succeeding lectures on October 18, 25 and November 1)*.

Tuesday, October 12

UNIVERSITY OF LONDON (at the Institution of Electrical Engineers, Victoria Embankment, W.C.2), at 5.30.—Prof. Erwin Meyer: "Electro-Acoustics" (succeeding lectures on October 13, 15, 18 and 20)*.

ILLUMINATING ENGINEERING SOCIETY (at the Lighting Service Bureau, 2 Savoy Hill, W.C.2), at 5.30.—Dr. S. English: Presidential Address.

Thursday, October 14

INSTITUTE OF FUEL (at the Geological Society, Burlington House, W.1), at 2.30. Sir Philip Dawson: "Coal: the Next Step" (Presidential Address).

At 3.30.—Prof. Morris W. Travers: "The Study of Gases" (Melchett Lecture).

CHADWICK PUBLIC LECTURE (at Manson House, 26 Portland Place, W.1), at 5.30.—Prof. W. A. Osborne: "The Study of Nutrition".*

CENTRAL HALL, LONDON, S.W.1, October 13-5. General Discussion on Lubrication and Lubricants.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

CHIEF LECTURER IN ELECTRICAL ENGINEERING in the West Ham Municipal College, Romford Road, Stratford, E.15.—The Principal (October 9).

TWO ASSISTANT KEEPERS on the Higher Technical Staff of the Science Museum, South Kensington, London, S.W.7.—The Director (October 11).

CIVILIAN EDUCATION OFFICER (Grade III—engineering or physics) in the Royal Air Force Educational Service.—The Air Ministry (E.S.1), Adastral House, Kingsway, London, W.C.2 (October 15).

TWO ASSISTANT TEACHERS OF MECHANICAL AND MARINE ENGINEERING in the Liverpool City Technical College.—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (October 16).

HEAD OF THE CHEMISTRY DEPARTMENT of Swansea Technical College.—The Director of Education, The Guildhall, Swansea (October 18).

ECONOMIST to the Ministry of Agriculture and Fisheries.—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (October 18).

HEAD OF THE CHEMISTRY DEPARTMENT of Northampton Polytechnic, St. John Street, London, E.C.1.—The Principal (October 31).

LECTURER IN THERMO-CHEMISTRY in the Imperial College of Science, Prince Consort Road, South Kensington, S.W.7.—The Secretary (November 8).

WATERWORKS ENGINEER for the Government of Nigeria.—Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/5340).

HEAD OF CHEMISTRY AND APPLIED CHEMISTRY DEPARTMENT of Salford Royal Technical College.—The Director of Education, Education Office, Chapel Street, Salford, 3.

ASSISTANT in the Intelligence Section of the Mineral Resources Department of the Imperial Institute, London, S.W.7.—The Establishment Officer.

Official Publications Received

Great Britain and Ireland

Air Raid Precautions. Memorandum No. 5: Anti-Gas Training. (Issued by the Home Office, Air Raid Precautions Department.) Pp. 28. (London: H.M. Stationery Office.) 4d. net. [219]

Report of a Joint Committee of the Chemical Society, the Faraday Society, and the Physical Society, on Symbols for Thermodynamical and Physico-Chemical Quantities and Conventions relating to their Use. Pp. 18. (London: Chemical Society.) 6d. [229]

Technical Publications of the International Tin Research and Development Council. Series D, No. 3: Mechanical Properties of some Tin Bronzes. By Dr. H. Lepp. Pp. 11. (London: International Tin Research and Development Council.) Free. [239]

Higher Education in East Africa: Report of the Commission appointed by the Secretary of State for the Colonies. (Colonial No. 142.) Pp. 136. (London: H.M. Stationery Office.) 2s. 6d. net. [239]

Report of Operations and Proceedings under the Land Drainage Act, 1930, from the passing of that Act (1st August 1930) to 31st March 1937. Pp. iv+75. (London: H.M. Stationery Office.) 1s. 6d. net. [239]

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1937. (M.O. 418.) Pp. 56. (London: H.M. Stationery Office.) 1s. net. [239]

Mines Department. Sixteenth Annual Report of the Secretary for Mines for the Year ended 31st December 1936, and the Twenty-ninth Annual Report of H.M. Chief Inspector of Mines for the same Period, with a Statistical Appendix to both Reports. Pp. 246. (London: H.M. Stationery Office.) 4s. net. [239]

The Royal Scottish Society of Arts. Pp. 24. (Edinburgh: Royal Scottish Society of Arts.) [249]

Post Office Green Papers. No. 36: Post Office (London) Railway. By Major W. G. Carter. Pp. 22+12 plates. (London: General Post Office.) [249]

Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 562: Some Moisture Relations of the Soils from the Erosion Experiment Stations. By L. B. Olmstead. Pp. 45. (Washington, D.C.: Government Printing Office.) 10 cents. [189]

Commonwealth of Australia. Report of the Eighth Australian Cancer Conference held at Canberra, 13th-16th April 1937. Pp. 66. (Canberra: Commonwealth Government Printer.) [189]

Annual Report of the Public Health Commissioner with the Government of India for 1935. Vol. 2. Pp. v+145. (Delhi: Manager of Publications.) 1.6 rupees; 2s. 6d. [189]

Colony and Protectorate of Kenya: Forest Department. Annual Report for the Year ended 31st December 1936. Pp. 34. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 1s. [209]

Kenya Colony and Protectorate: Department of Agriculture. Annual Report, 1936. Vol. 1. Pp. ii+184. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 2s. 6d. [209]

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1936. Pp. ii+48. (Calcutta: Government of India Press.) [219]

Southern Rhodesia: Geological Survey. Bulletin No. 32: The Geology of the Umtali Gold Belt. By A. E. Phaup. Pp. iv+186+15 plates. (Salisbury: Government Stationery Office.) 5s. [219]

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1933. Pp. 27. Regenwaarnemingen in Nederlandsch-Indië. Zeven en vijftigste Jaargang 1935. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [219]

Transactions of the Geological Society of South Africa. Annexure to Vol. 39: The Pioneers in South African Geology and their Work. By A. W. Rogers. Pp. ii+139+8 plates. (Johannesburg: Geological Society of South Africa.) [219]

Cooper Ornithological Club. Pacific Coast Avifauna, No. 25: The Natural History of Magpies. By Jean M. Lindsay. Pp. 234. (Berkeley, Calif.: Cooper Ornithological Club.) [219]

Ministerio da Agricultura: Serviço Geológico e Mineralógico. Relatório do Director de 1º de Janeiro a 31 de Julho 1933. Pp. 48. Boletim N. 84: Brachyopodus do Rio Paranaury. Por Aristomenes Guimarães Duarte. Pp. 44+7 plates. Boletim N. 85: Prospeccão magnética no norte de Santa Catharina. Por Mark C. Malampuy, H. Capper A. De Souza, Irnaek C. Do Amaral. Pp. 24+19 plates. Monographias, Vol. 11: O cretáceo de Sergipe. Pela Dra. Carlotta Joaquina Maury. Pp. 283. Album des estampas da Monographia N. 11. Pp. xxxv+28 plates. Publicação Avulsa 29: A política do Ouro. Por Euzébio Paulo de Oliveira. Pp. 46. (Rio de Janeiro: Departamento Nacional da Produção Mineral.) [249]

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 14: Items 3479-3565, April, May, June 1937. By Ernest A. Hodgson. Pp. 289-300. (Ottawa: King's Printer.) 25 cents. [249]

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 18, No. 10 (Mathematics No. 26): Beiträge zur Geometrie der Kreise und Kugeln, 19. Von Sôzi Matsumura. Pp. 229-240. (Taihoku: Taihoku Imperial University.) [249]

India Meteorological Department. Scientific Notes, Vol. 7, No. 72: Normal Monthly Percentage Frequencies of Surface and Upper Winds up to 8 km. at Allahabad, Begumpet, Delhi, Sambalpur, Sandaway, Slicher and Victoria Point. Pp. 35-58. 12 annas; 1s. 3d. Scientific Notes, Vol. 7, No. 73: Daily Variations of Temperature and Pressure at Different Levels over Agra associated with passage of Western Disturbances. By S. P. Venkiteshwaran. Pp. 69-64+7 plates. 12 annas; 1s. 3d. (Delhi: Manager of Publications.) [279]

Imperial Council of Agricultural Research, India. Scientific Monograph No. 11: Investigations on the Course and Distribution of the Nerves supplying Levator Anguli Scapuli and Rhomboides Muscles and the Formation of the Phrenic Nerve in the Ox, with Observations on certain Anatomical Deviations. By H. N. Chelva Ayyangar. Pp. v+60+57 plates. (Delhi: Manager of Publications.) 4.10 rupees; 7s. 9d. [279]

Annual Report on the Departments of Agriculture, Malaya, for the Year 1936. By O. T. Faulkner. Pp. iv+81. (Kuala Lumpur: Government Printer.) 1 dollar; 2s. 4d. [279]

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3546

SATURDAY, OCTOBER 16, 1937

Vol. 140

Physiology in General Education

UNTIL within very recent times, the study of the human body was practically solely the concern of physiological departments in medical schools. Undergraduates outside the medical curriculum had no opportunity of studying human physiology, and the people of Great Britain as a whole seemed well content to leave the control of their lives with respect to health and disease to the guidance of the medical profession. Thus, when 'science' was first introduced into the schools, educationists turned to chemistry and to physics, and, even to-day, such biology as is taught in schools deals almost wholly with plants and lower animals. That "the proper study of mankind is man" was the keynote of the discussion on "Physiology in General Education" in Section I (Physiology) of the British Association during the recent Nottingham meeting.

All the speakers in the discussions were unanimous that this loss of contact between human physiology and general education is a misfortune, not only for a modern democracy but also for physiology itself. Experimental psychology, which, as practised to-day, is but a branch of experimental physiology, has hived off from physiology, largely due to the absorption of physiologists in the needs of medical students. Biochemistry is shifting its camp from physiology to organic chemistry probably for the same reason.

This unfortunate lack of facility for study of human physiology in British universities reacts on school education and on adult education. The future school teacher has to rely almost wholly on training centres for instruction in human physiology and hygiene. These facilities, although admirable in many cases, are not to be compared with those already in being in our universities.

The end-result is that the content of physiological knowledge of the 'man in the street', and even of his legislators, is at a dangerously low level.

Moreover, whenever there is loss of contact between the practising scientific investigator and the public, there arises inevitably the risk of loss of understanding and of sympathy. The agitation against vivisection is very largely due to ignorance, on the part of the public, of physiological practice, and of the vital part played by physiological research in everyday life.

But the physiologist is not the only sufferer. From the cradle—and even earlier—to the grave, physiological first principles affect our health and well-being. In a modern civilized community it is no longer possible to rely solely on the bounty of Nature for our food and proper nourishment, or on our natural instincts for the conduct of our own and others' lives. The public, crassly ignorant for the most part of the elementary facts about the human body, ignores the simplest dietetic principles, falls victim to the specious advertisements of the vendors of fortified foodstuffs and of quack nostrums, and blindly follows the fatuous dictates of the latest fashion. Moreover, as one speaker in the discussion at Nottingham emphasized, all propaganda and legislation in the interests of public health must of necessity lose the greater part of their effectiveness if the public is incapable of appreciating the significance of, and reasons for, such activities.

After the comments made by Mr. H. G. Wells upon the teaching profession at this meeting of the British Association, it might have been expected that school teachers would not be in a mood to suffer tamely further suggestions from amateur, as

distinct from professional, educationists. Nevertheless, there was no protest at the suggestion that, to make way for the necessary instruction in human physiology, either some subject at present in the school curriculum would have to be dropped or a compromise effected by using human physiology as an introduction to, and a vehicle for, the teaching of general biology. It was pointed out that it is a sound pedagogic principle to proceed from the known, or at least the familiar, to the unknown. Study of the human body and of its functions is an admirable introduction to the study of other forms of life and of biological principles in general. Moreover, human physiology gives great scope for practical work with the minimum of apparatus; in short, it is good science, good biology and admirably adapted to school instruction.

Although the day is long past when all mention of human structure and of human function was taboo, yet some fear was expressed during the discussion that teaching of human physiology might lead to unhealthy self-consciousness and introspection on the part of the pupils. The

general opinion seemed to be, however, that such a danger is more likely to arise in the course of unofficial health talks conducted by enthusiastic but unskilled instructors than in routine school teaching. Indeed, Prof. Winifred Cullis, from her wide experience, believes that school instruction in human physiology, so far from inducing morbid preoccupation with the functions of the body, would rather tend to ventilate and bring into the unemotional atmosphere of the schoolroom, and thus into proper perspective, many matters which, even to-day, the modern child is shy of discussing with its elders.

The meeting was a very large one for a purely sectional discussion, and the fact that the practising physiologists were in an extremely small minority is an indication of the widespread interest the subject aroused. From every point of view it was unfortunate that a joint discussion with Section L (Educational Science) could not be arranged, for the time has clearly arrived when the place of physiology or human biology in school science courses must be given serious attention.

Registration and Privilege

THE extent to which the principles of 'free trade' are inbred in the people of Great Britain is well illustrated by the statutory provisions governing the registration of medical practitioners and pharmacists. For both professions the State establishes standards of education and examination, with a statutory register of those who reach them. To permit the public to differentiate between the qualified and the unqualified practitioner, the use of titles implying registration is prohibited and the signing of death certificates, the sale of poisons, and other minor matters are controlled. But in both medicine and pharmacy the practice of the calling by unregistered men has few statutory limitations.

By way of contrast, the lawyer is well protected. It is a statutory offence for a layman to practise as a solicitor, and in the High Court His Majesty's judges will neither see nor hear the advocate who is not a barrister. Accountants and architects have certain titles reserved to them, but few other statutory privileges. The high-water mark of protection for a calling is probably that given to dentists, the Dentists Act of 1921 making

it an offence for the unregistered to "practise dentistry".

Many attempts have been made in recent years to persuade Parliament to regulate the practitioners of a calling by means of a statutory register and to provide statutory privileges for the registered. The destruction of the Osteopaths Bill exemplifies the fate of such attempts. It is in the totalitarian States that there will be found the modern examples of restrictive legislation for the control and benefit of individual callings and their protection from competition. Whether the price to be paid compensates for the advantages, even to the sheltered practitioner himself, is a question the answer to which depends upon the temperament of the individual. The majority of the people of Great Britain are not temperamentally inclined to a régime of professional corporations, even for personal benefits, and that spirit is reflected in the attitude of Parliament towards Bills proposing to accord privileges to closed professions.

Nevertheless, there is a price to be paid for freedom. In the medical and pharmaceutical fields the price is the exploitation of the public by the

quack. Probably at no time in history has the British public provided so rich a field for the pseudo-scientific medicine-man with his tale of vitamins and hormones, rings, belts and exercises, massages and diets. *The Times* publishes its National Health Number, with the dominant note of healthy exercise outdoors, while from every hoarding, bus and tram an attempt is made to mesmerize the public into mass drugging.

A year ago, when the House of Commons was

invited to discuss this question on the second reading of the Medicines and Surgical Appliances (Advertisement) Bill, the House was counted out. It is small wonder that with public opinion so docile, the proprietary medicine industry was able to claim before the Select Committee on Medicine Stamp Duties in December last that the capital in the industry is £100,000,000, and that it spends between £12,000,000 and £15,000,000 annually in advertising its wares.

Air Raid Precautions

Air Defence and the Civil Population

By Dr. H. Montgomery Hyde and G. R. Falkiner Nuttall. Pp. xvi + 239 + 8 plates. (London: The Cresset Press, Ltd., 1937.) 12s. 6d. net.

THIS book has been written for the benefit of the 'man in the street'. It contains a moderate statement of the various risks to which the ordinary citizen may be subjected in an aerial bombardment, and explains the most effective methods of providing protection against them—collective, individual and structural.

The authors are generally in agreement with the recommendations made by the Air Raid Precautions Department of the Home Office, but they submit certain criticisms, the chief of which is the ineffectiveness of its propaganda, as public interest in the subject has not been aroused, nor has readiness on the part of the public to co-operate in defensive measures been achieved to the extent which both the seriousness of the international situation and the progress of military preparations throughout Europe plainly demand. They consider that, in the circumstances, instruction in passive defence should be as integral a part of the life of the nation as vaccination and the registration of vital statistics.

In striking contrast with this apparent apathy, the developments that have taken place in all Continental countries—including Holland and the Scandinavian group which were neutral in the Great War—are briefly summarized. In Germany, Italy and Russia a standard knowledge of anti-gas precautions is obligatory, and the whole civilian community is compelled to co-operate with the authorities in experiments of different kinds. 'Black-outs' are of common occurrence in all the chief cities, and the most realistic conditions are created, including the intentional bursting of water and gas mains and the daubing with red paint of the 'casualties' before they are

removed in the ambulances, in order to reproduce the situation that may have to be dealt with: everybody must take cover on the air raid warning being given, and even foreign tourists are punished if they disobey any of the orders. Public shelters are being built and municipal buildings strengthened, while in all important business premises and factories the provision of protection for the employees is compulsory. In Italy, instruction in passive defence measures is given from a series of gramophone records which are sold at specially reduced prices; while in Russia, General Eideman, the head of the Air Defence Department, was among the generals who were recently shot in Moscow, the official explanation given being that his organization was 'on the down grade'!

In Czechoslovakia a law has recently been enacted compelling all housing contractors to provide bomb-proof shelters in the cellars for the protection of their tenants; and in France, where the experience gained in the construction of the Maginot line has been of particular value, a Bill has been passed empowering the Government to evacuate the civilian population where necessary, and to build bomb- and gas-proof shelters: in the Seine Department alone, £1½ millions were voted two years ago to finance air raid precautions.

While all these measures are accepted by our neighbours with enthusiastic co-operation, our own lack of interest is all the more remarkable as we are exceptionally vulnerable to attack, and the outstanding characteristic of future air raids is that they may come suddenly and unexpectedly and may well precede any formal declaration of war. (When a practice 'black-out' was suggested in Brighton a few days ago an alderman was reported to have protested against frightening the visitors, while a councillor described the proposals as "this air raid nonsense".)

The authors are, however, by no means alarmist in their conclusions. They consider that poison gas should not be regarded as the deadliest weapon in the hands of a potential enemy; and that the heaviest type of high-explosive bombs against which, we are told, a roof covering of 12-15 feet of reinforced concrete is necessary, are so costly and the number that can be carried by aircraft so small, relatively, that their use in war will be confined to special objectives, and they will not be deliberately employed against the civil population. Incendiary bombs are now believed to constitute the greatest danger to civilian communities, as the agents available are greatly superior to those employed in the early Zeppelin raids on London, which proved to be very disappointing to the attackers in the results achieved. While certain public services, such as central telephone exchanges, must be protected from interruption at all costs, gas- and splinter-proof protection is all that should normally be aimed

at for private houses, after all inflammable materials have been removed from the attics.

This book is written in simple language, and it should be widely read: a great deal of industry has been required to collect the material necessary for its compilation and the matter is well arranged. It is well established that the Italians used mustard gas in their Abyssinian campaign, but it will be news to most people in Great Britain that gas has been used by both sides in the civil war in Spain. The authors seem to have access to sources of information not supplied to, or at any rate not published by, our newspapers, so it is to be hoped that in future editions of their work details will be given of the effects produced and of the types and weights of the projectiles that are being used in the aerial bombardments there, as these are possibly being 'tried out' by nations who may be engaged in the next European conflict, if and when it overtakes us.

C. H. F.

The Problem of the Portolan Charts

Hallucinations scientifiques (les portulans)

Par le Prince Youssouf Kamal. Pp. 96 + 39 plates. (Leiden: E. J. Brill, Ltd., 1937.) n.p.

PRINCE YOUSSEUF KAMAL is known not only as the owner of an unusually fine collection of early maps, brought together with little regard to cost, but also as a keen student of their history, so that anything written by him on the subject merits attention. His big folio volumes containing, or to contain, facsimiles of all the most important early maps of Egypt or of Africa as a whole (with which, as an Egyptian, he is specially interested) are monuments of sumptuous reproduction. The present work claims no such importance, and one cannot help wishing that he had waited to give a systematic discussion of the old Portolan Charts and their origin, for he should be well qualified to undertake such a study. As it is, the work is somewhat scrappy and disjointed, its main object being to combat the theory put forward by a recent writer, Prof. J. H. Kramers of Leyden, who believes that the nautical charts produced in the Western Mediterranean, which make their first known appearance, already in fully developed form, about A.D. 1300, owed much to previous work of the kind in the East, especially that of the Arab geographers El Bakri and Edrisi. It is this to which the term "Hallucinations" of the title is applied.

One must allow that no convincing arguments have been produced in support of the theory, and Prince Kamal's counter-arguments will no doubt on the whole meet with approval, though perhaps open to criticism in some particulars. He holds that the charts were first produced, in the West, to meet the practical needs of sailors in that part of the world, at a time when trading voyages began to be extended farther afield than previously—to the north coasts of Africa for example. He has no difficulty in showing that the point of view of men like El Bakri and Edrisi was quite different from that of the chart-makers, their descriptions being almost entirely based on land-routes. As to the appearance of Arabic names on the charts—previous Western literature having mostly adopted those of the Greeks and Romans—this was an obvious necessity if the charts were to be of practical value. This may be conceded, but it surely does not follow, as Prince Kamal seems to imply, that nothing in the way of charts, as distinct from sailing directions, had been used in the East previous to about 1300. Similar need might be expected to produce a similar help.

Prince Kamal also rejects the idea that the wind-roses of the charts, with the elaborate system of radiating lines, may be an indication of Eastern (perhaps Greek) influence. He holds that the chief object of the lines was not that of direction-pointers, but of helping the draughtsman to

copy his sources, like the 'squaring' used by modern map-makers. Curiously enough, he seems almost to regard the figures produced by the intersection of the lines as the reason for drawing them, instead of being merely an incidental result.

The general tone of the work, and the occasional long and somewhat involved sentences, make it a little difficult to grasp the writer's motive in producing it, for he begins by stressing the small likelihood there is of arriving at any conclusion—one section is actually headed "Conclusion (sans conclusion)". Similarly, he thinks that no good result can be gained by a detailed comparison of the respective contents of the charts and the Oriental works, yet he is at great pains to supply the material for such a comparison, for the sake

of such as wish to make it. This forms the most substantial part of the work, including not only reproductions of the North African portions of the most important early maps down to and including the Portolan Charts, but also comprehensive lists of names, distances, and geographical co-ordinates derived from the early literature, both Eastern and Western. This part will supply a useful basis for study to those who may not have access to the bigger works in which the field had been covered previously to some extent.

On one point at least one may cordially agree with the author—that relative accuracy in a map is no proof that it is later in date than another, as is too often assumed. It is not to be thought that every map-maker would be conversant with all the best work of his predecessors.

E. H.

Fundamentals of Zoogeography

General Zoogeography

By Prof. V. G. Heptner. (In Russian.) Pp. 548. (Moscow and Leningrad: Gosudarstvennoe Izdatelstvo Biologicheskoi i Meditsinskoi Literatury, 1936.) 13.50 roubles.

THE recent rapid advances in the study of animal ecology, historical geology and palaeoclimatology are making inadequate the old formal zoogeography, which consisted mainly in the accumulation of distributional facts and in the parcelling out the earth's surface into rigidly defined zoogeographical regions, provinces, etc. An urgent necessity for revising the fundamental conceptions and methods of zoogeographical research, in order to bring it into line with allied sciences, is felt by all biologists working on distributional problems, whose aim is not merely to register facts, but also to find the most probable scientific theories accounting for their origin. There is no lack of attempts at such revisions, but none of them can be considered sufficiently balanced. Usually there is a distinct bias either towards pure ecology, which is taken to provide a complete explanation of all distributional facts, or the stress is laid on geological history, and very ingenious theories are built on an incomplete foundation.

The book under review represents another attempt of this kind and certainly a very successful one. The first part contains a most instructive introduction to the subject-matter of modern zoogeography and a clear representation of basic ecological principles, namely, factors of existence,

ecological valency, optimum and pessimum, habitat concept, biological types (life-forms) and biocenoses. The second part is devoted to a more detailed analysis of the environment and of environmental factors, both in water and on dry land, and ends with a classification of the main ecological formations (biotops) of dry land, with their characteristic faunas. The problems of the dispersal of animals and of the area of a species occupy the longest, and the best, part of the book, where special attention is given to various types of discontinuity and their origin. The final (fourth) part deals with comparative zoogeography, that is, with brief descriptions of the different zoogeographical regions, and has special sections on the fauna of the U.S.S.R., and of the seas.

The most valuable quality of the book is the abundance of reliable and fresh facts most carefully collected from an immensely scattered literature. In this respect, the author can be criticized only for paying too much attention to vertebrates and for neglecting to a certain extent the literature on invertebrates, more particularly on insects, where a great amount of very valuable data has been recently accumulated with the development of modern ecological trends in entomology.

Amongst other points deserving to be mentioned in a critical review is the omission of the consideration of palaeoclimatic factors in the evolution and movements of animal populations. One may not accept without reservation the Koeppen-Wegener schemes of displacements of climatic zones in the

past, but they should be at least mentioned in a book of this kind. Another weak point is the lack of discussion on ecoclimates of the actual animal habitats, which very often enable an animal to survive in a region the general climate of which is wholly unsuitable for it.

On the whole, however, the book represents an outstanding contribution to the development of

biogeographical science, and it is a matter of regret that its language will make it inaccessible to most workers and students outside Russia. Biogeography is now entering a period of intensive development and there is no text-book in any language that could be recommended more thoroughly than the present one.

B. P. UVAROV.

Latin Clarity and the Sciences of Life

Encyclopédie française

Tome 4: La vie. Dirigé par André Mayer. Pp. 582. (Paris: Société de gestion de L'Encyclopédie française; Libr. Larousse, 1937.) n.p.

THE great difficulty confronting all those who wish to give a connected account of the sciences of life is that of steering between the Scylla of excessive popularity and the Charybdis of technicality. Where certain special but fundamental sciences are concerned, such as biochemistry and genetics, the relative unfamiliarity of their concepts to the general reader leads to a failure to do them justice and hence to an unfair emphasis. The present volume of the French Encyclopædia, in which some fifty French scientists have collaborated to describe the main outlines of the sciences of life, seems to overcome these difficulties better than any English book. The excellent "Animal Biology" of Haldane and Huxley is very short, while the two-volume "Life" of Thomson and Geddes suffers particularly from the failure just referred to.

The book now under review gives a good initial impression, for its several fascicules are bound in loose-leaf style, suggesting that new ones may be issued as important advances occur, to take the place of some of the present ones. After a quite striking frontispiece, which represents a binocular microscope against the background of a monster Purkinje cell, the book opens with a section on the cosmic setting of life, its chemical actions on the outer world, and such subjects as the cycles of carbon, nitrogen and other elements. The second section deals with the constitution of living organisms. Concise accounts of the colloidal state, of the main groups of chemical substances from which living matter is built up, and of the actions of enzymes, are given. Section 3 is entitled "The Structure of Living Beings", and is devoted to experimental cytology, the equilibrium of the cell with its environment, etc.; Section 4, "The Actions of Living Beings", deals with movement,

adhesion, phagocytosis, luminescence, muscular contraction, ciliary movement and similar topics. In Section 5, "The Forms of Life", a wide survey of comparative physiology shows how morphology and function are intertwined in many groups of animals, and Section 6, "The Maintenance of Life", discusses metabolism, reflexes, the fixity of the internal medium, cicatrization, regeneration, etc. Latent life, radiation effects, chemical agents and immunity have a section to themselves under the head of "Repairs and Alterations in Living Organisms", while the book ends with a section on the transmission of life in which the whole of embryology and genetics are passed under review.

The outstanding impression left by the work is one of clarity and logic. The arrangement of the sections is unusually clearly thought out, and although the comparative anatomy of animals and plants is throughout in the background, this would follow from the predominantly physiological outlook with which the book is written. Where such a broad canvas has so successfully been painted, it would be almost pettifoggish to complain of the confusingly wrong formula for vitamin B₁ on p. 4.12-5 or of the persistent absence of magnification data in the illustrations, so that a guileless reader might obtain almost any fantastic idea of the sizes of the biological objects shown. But it must be admitted that some of the sections, perhaps especially those on oxidation-reductions and fermentation, give the impression of having been written about ten years ago. One might also suggest that the formulæ of substances should be given where their physiological functions are discussed, or at least a cross-reference inserted; for example, adrenaline and acetylcholine on p. 4.36-15, auxin on p. 4.60-9. In general, however, the book will be of immense value to all Frenchmen of reasonable intelligence who wish to gain an accurate view of modern biology, and it is a pity that Englishmen will not be able to share it with them unless someone should attempt the heavy task of a translation. JOSEPH NEEDHAM.

Interracial Marriage in Hawaii:
a Study of the Mutually Conditioned Processes of
Acculturation and Amalgamation. By Romanzo
Adams. Pp. xviii+353+11 plates. (New York:
The Macmillan Co., 1937.) 18s. net.

STUDENTS of the inter-relationships between groups of people of different racial and cultural origins have long been interested in Hawaii, "the melting-pot of the Pacific", where Americans, Japanese, Chinese, Filipinos, Portuguese, native Hawaiians and others have worked out a *modus vivendi* with, apparently, the minimum of friction. Dr. Adams has given us an elaborate and well-documented analysis of this situation.

An examination of the present racial composition of the population and degree of race mixture is followed by a series of investigations of the component groups and the part they play in the communal life. Valuable correction of census material is embodied throughout. A most interesting section deals with the social background of interracial marriage. There is no general theory of racial inequality or any organized public sentiment against intermarriage between members of the different racial groups. Personal and family sentiment against it is shown to exist, but it is argued that the frequency in practice is so great that it would be difficult for a widespread adverse social sentiment to form. The author attributes this situation to a variety of historical reasons, including the absence of white women at the earlier stages of intermixture, the marital freedom of the native Hawaiians, the advent of the early missionaries from New England and not from the Southern States of America, and the absence of a single "dominant race". He has perhaps underestimated here the importance of the compatibility of the physical traits, temperament and intelligence of the Hawaiians with those of the immigrants, in facilitating intermarriage on a basis of equality (relations between European and Maori in New Zealand may be compared with this).

It is possible also that the low rate of marriage of "Other Caucasian" (mainly non-Latin) women with other groups such as the part-Hawaiian, and the tendency to increasing cultural segregation of the part-Hawaiian group have been minimized by the author in his prediction that, by the end of the present century, the majority of the people of Hawaii will constitute a stable race mixture of hybrids, culturally homogeneous. But fact and inference are clearly separated in the book, which is an extremely valuable study in an important field. One looks forward to seeing more publications on this subject, sponsored, as in this case, by the enterprise of the University of Hawaii. R. F.

The Subject Index to Periodicals, 1936
Issued by the Library Association. Pp. xii+300.
(London: Library Association, 1937.) 70s.

THE Library Association and its general editor, Mr. T. Rowland Powel, are to be congratulated on the coming of age of the "Subject Index to Periodicals",

this being the twenty-first year of the existence of the Index. As was also the case last year, the volume for 1936 appeared only five months after the close of the year covered.

The volume for 1936 contains references to more than 27,000 articles selected from no fewer than 597 periodicals. Of these periodicals 547 are English and American, 27 French and Belgian, 21 German and 2 Italian. The articles are arranged under headings such as 'Floodlighting', 'Mural Painting' and 'Radio-activity', but under each heading the order is that of authors' names. The subjects selected for indexing cover a wide range, but verse and fiction are excluded.

With some important exceptions, no attempt has been made to index periodicals covered by the following publications: *Agricultural Index*, *Engineering Abstracts*, *Engineering Index*, *Index Medicus*, *Journal of the Society of Dyers and Colorists*, *Photographic Abstracts*, *Revue de Géologie*, *Minéralogie et Crystallographie*, *Royal Meteorological Society's Bibliography*, *Science Abstracts* and *Technical Institute Journal*.

These Subject Indexes are much appreciated by those to whom a knowledge of the latest researches on scientific problems is of importance, for without such works of reference at hand it is quite possible that many a valuable paper may be overlooked. We congratulate the Library Association on the promptitude with which these annual volumes are published.

Gravimetric Analysis:

a Laboratory Manual with Special Reference to the Analysis of Natural Minerals and Rocks. By W. van Tongeren. Pp. xi+278. (Amsterdam: D. B. Centen's Uitgevers-Maatschappij N.V.; London: H. K. Lewis and Co., Ltd., 1937.) 14s. net.

THIS text-book, written by one having considerable practical experience, will be welcomed by mineralogists and analytical chemists generally. It gives a critical description of modern gravimetric analytical methods in a very convenient form.

The plan adopted by the author is the logical one based on geochemical principles. The text is well illustrated by useful diagrams, where the technique involves such for clearer explanation, and the tables are clearly set out. The few typographical errors seem to constitute the only minor drawback to the book. There are three indexes, devoted to apparatus, reagents and determinations respectively, and this arrangement makes reference unusually easy.

Assay methods, or as the author prefers to designate them, "docimastic methods", for the noble metals are beyond the scope of this book; their inclusion would not have added to its value and would certainly have added greatly to its bulk. The bibliography is adequate, accurate and up-to-date, and naturally the names of such well-known workers in this field as Hillebrand, Hevesy and Goldschmidt constantly recur in it. Of all the names mentioned only some six per cent are those of British investigators, indicating that insufficient attention is paid in Great Britain to the scientifically and economically important subject of geochemistry. C. S. G.

The Ohio-Mississippi Floods of 1937

By R. W. Davenport, U.S. Geological Survey

SOME of the recent floods in the United States have indicated that, in any appraisal of the potentialities of a river system for producing floods, more significance than has perhaps been customary should be attached to the magnitude

settlement of the region by white men, thus making a skeleton record going back one to three hundred years, varying with the time of such settlement. The available records may be sufficient to show with considerable reliability the characteristics of a river in respect to the magnitude and frequency of lesser floods, but such records are entirely inadequate for disclosing the expectancy of the rare floods of great magnitude.

In March 1936, floods occurred in the north-eastern part of the United States which caused crests on many rivers that were higher by several feet than had been recorded since the settlement of the country. Similarly, the more recent extraordinary floods of January and February 1937 in the Ohio and mid-Mississippi Valleys were greater than any known since the time of white settlement. Stages higher than previously recorded occurred on the Ohio River from Point Pleasant, W. Va., to its mouth at Cairo, Ill., a distance of about 700 miles, and on the Mississippi River from the

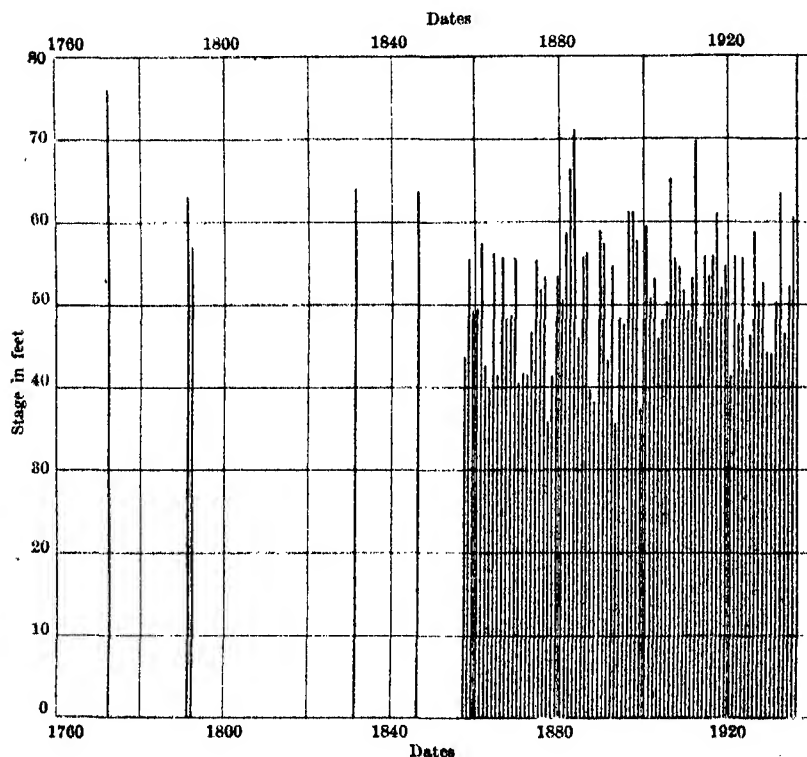


Fig. 1.

MAXIMUM ANNUAL FLOOD STAGES, OHIO RIVER, CINCINNATI, OHIO, 1858-1937.
(CHRONOLOGICAL ARRANGEMENT).

of the great floods of the past, as disclosed by Nature's records of them. A conspicuous part of the work of rivers in the processes of dynamic geology is associated with the occurrence of major floods, and significant information with respect to such floods may be appropriately and reliably interpreted from the flood plains, terraces, earlier river channels, and other evidences of erosion and deposition which record a river's past behaviour.

Systematic records of flood stages on rivers in the United States do not generally extend back more than fifty or sixty years at most. Knowledge of earlier flood stages may cover, with considerable completeness for some rivers but usually without much detail, the outstanding floods since

mouth of the Ohio to a point below Helena, Ark., a distance of more than 300 miles. The excess of the flood crests above the highest previous records was greatest in the vicinity of Louisville, Ky., where all previous stages were exceeded by 10-11 feet. At Cincinnati, Ohio, the flood crest was 8-9 feet higher than had occurred in eighty years of continuous record and 4 feet higher than the highest previously known stage, which is reported to have occurred in 1773. With rare exceptions, the protective levee systems were overtopped and great damage to property and considerable loss of life were caused in cities, towns, industrial establishments and transportation routes that occupied the flood plain.

Fig. 1 shows by bars in chronological order the maximum yearly stages of the Ohio River at Cincinnati, Ohio, continuously for the eighty years, 1858-1937, inclusive, and for certain major floods prior to that period.

Fig. 2 shows, as explained thereon, the maximum yearly stages at this place for the eighty years above specified, arranged in order of magnitude and plotted upon arithmetic-probability paper. The graduations on this paper have the characteristics that if a series follows the laws of normal probability the plotted points will define a straight line. This type of graduation is used because it seems to show the observed data effectively.

In so far as Fig. 2 illustrates the magnitude-frequency characteristics of the Ohio River in the production of floods at Cincinnati, the river does not seem to have departed far from its demonstrated character in producing the excessive stage of 1937. However, on the basis of the records prior to 1937, it is probable that the deduction would have been warranted that such a stage as occurred in 1937 would be of such rare occurrence as to justify little consideration with respect to protective works or occupancy of the flood plains. In the popular mind a flood of such magnitude was considered essentially impossible.

The series of rains which caused these record-breaking Ohio-Mississippi floods began toward the end of December 1936, continued through most of January and were unusually excessive in the latter month. The associated weather conditions resulted from abnormal movements and interactions of air masses over a large region. The distribution of barometric pressure "resulted in a continuous northward and north-eastward movement of tropical air masses over the area roughly from Louisiana and Tennessee eastward to the Atlantic States, New England and New York, while air masses of polar origin moved southward almost continuously over much of the western half of the United States. . . .

"The extremely heavy rainfall over the Ohio Valley, Tennessee and Arkansas and part of the adjoining areas was in general caused by the fact

that this area was so located with relation to the very deep areas of high pressure on either side that at the earth's surface the line of contact between the warm, moist air from the south, and the dense, cold air of polar origin that came in over the Ohio and middle Mississippi Valleys on many days from the north and north-east, lay somewhere over this area much of the time; and the less dense warm air from the south (or south-west) was forced to rise over the cold and denser air. The rapid lifting of the very moist air of tropical origin resulted in abundant precipitation."*

The total rainfall for the month of January

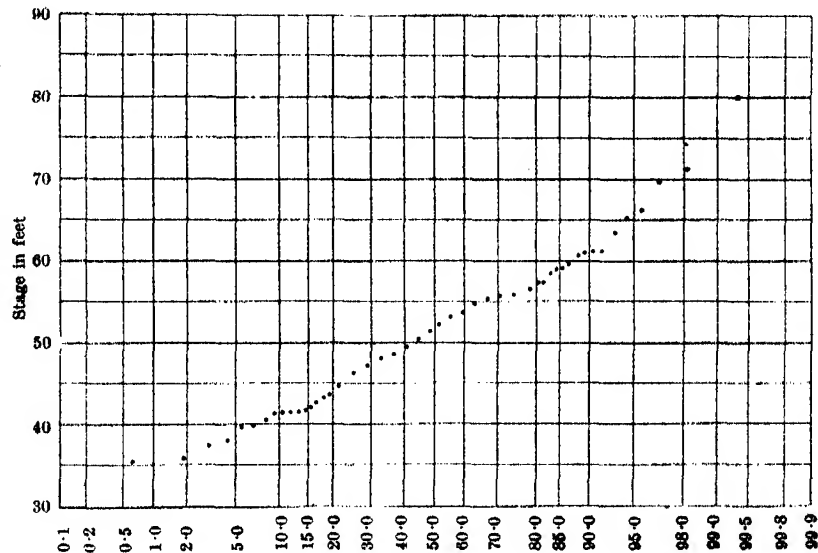


Fig. 2.

MAXIMUM ANNUAL FLOOD STAGES, OHIO RIVER, CINCINNATI, OHIO, 1858-1937. RECORDS PLOTTED IN ORDER OF MAGNITUDE ON ARITHMETIC PROBABILITY PAPER. FOR THE MID-48 YEARS, THE PLOTTED POINTS CORRESPOND TO THE MEANS OF SUCCESSIVE GROUPS OF THREE YEARS IN ORDER TO AVOID CONFUSION CAUSED BY A MULTIPLICITY OF PLOTTED POINTS.

was four times the normal, or more, over approximately 35,000 square miles. The area of heaviest precipitation included the middle and lower Ohio River valley, mainly along the Ohio River and the lower valleys of its tributaries (Fig. 3). The rainfall occurred not so much in a progression of general storms through the region as in a progression of somewhat sporadic storms marked by considerable variation in local distribution, and moving in a general north and north-east direction. The average rainfall in January over the drainage basin (203,000 square miles) of the Ohio was slightly more than 11 inches.

The floods occurred in a season when normally there might have been considerable snow, but, because of the prevalence of exceptionally

*Statement by C. L. Mitchell, forecaster, United States Weather Bureau, *Monthly Weather Review* February, 1937, p. 72.

warm winter temperatures, the snowfall was light and had no appreciable influence on the floods.

The rains in December and early January reduced the capacity for surface storage and absorption by the ground that otherwise would have been available, and filled the channels of lower reaches of the rivers which later were sub-

1936 originated in the tributaries of the upper Ohio River and caused record-breaking stages at Pittsburgh, Pa., and for a distance of approximately 100 miles below that city. The peak which occurred at Pittsburgh on March 18 reached Louisville, Ky., a distance of about 600 miles, 11 days later, on March 29. In contrast, the 1937 flood

reached its crest at Pittsburgh on January 26 and at Louisville on January 27, thus giving evidence of extreme concentrations of flood waters nearly simultaneously in several hundreds of miles of the channel of the Ohio River. The flood was at crest at the mouth of the Ohio River, a distance of 980 miles below Pittsburgh, on February 3. This crest moved down the Mississippi and reached Memphis, Tenn., a distance of 227 miles, on February 10; Vicksburg, Miss., a distance of 602 miles, on February 21; and New Orleans, a distance of 960 miles, on February 28. At Cairo, Ill., at the mouth of the Ohio, the Ohio and Mississippi were higher for a period of nineteen days, from January 24 until February 11, than any previous record. Preliminary computations indicate that the mean discharge of the Ohio River for this nineteen-day period was approximately 1,650,000 c.f.s. from a drainage area of 203,000 square miles—about 8 c.f.s. per square mile. The maximum discharge was about 1,850,000 c.f.s.

Topographic maps show a pronounced flood plain adjacent to the Ohio River, in the middle and lower valley. At the margin of the flood plain the reduction of spacing of the contours is so marked as to produce an effective visual impression as to the location of this margin. A definition by outline of the overflow areas of the 1937 floods indicates the apparent flood plain to have been almost

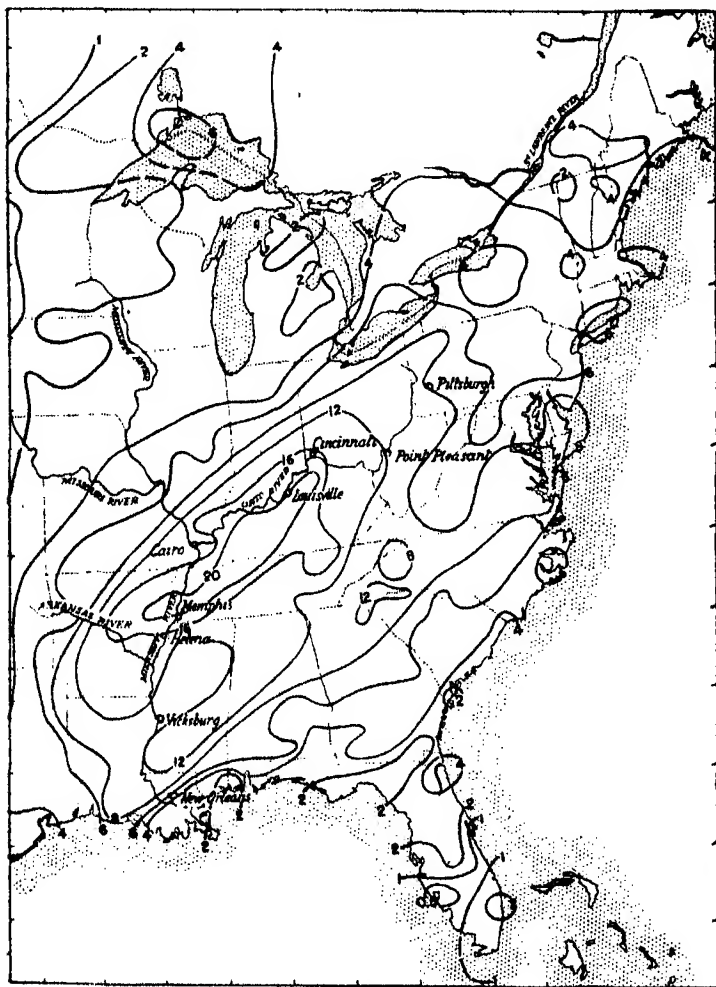


Fig. 3

TOTAL PRECIPITATION IN INCHES, JANUARY 1937, FROM UNITED STATES WEATHER BUREAU *Monthly Weather Review*, JANUARY 1937.

ject to the most excessive rainfall. As a result, an exceptionally large part of the heavy rainfall of January 20-25 ran into the streams. The especially heavy rainfall in the middle and lower Ohio Valleys was essentially superimposed upon full rivers resulting from the preceding days of rain in the upper parts of the basin.

The peculiarities of the floods of 1937 may be illustrated by a comparison with the floods of March 1936 in relation to the progression of flood crests down the Ohio River. The floods of March

wholly occupied from the vicinity of Cincinnati to the mouth. Above Cincinnati, as the excess above previous crests decreased, increasingly more of the flood plain appears outside the overflow area.

In order to produce the characteristic topography of this valley, the Ohio in past ages must many times have occupied the flood plain in a degree similar to that of 1937. The evidence and experience seem to demonstrate that there is a place in the planning of flood control works for

appropriate consideration of the recurrence of the great floods which geological evidence shows have occurred many times in the past. Such consideration would serve as a corrective against failure to realize adequately that a series of rains like that which produced the 1937 floods can recur, and also would tend to produce a more sound understanding and befitting humility as to the

limitations of the works of man in effectiveness against all possible floods. Nature can produce floods which it may not be practicable for man to control, and it behoves man in the municipal and industrial development of river valleys not to overlook the need for meeting those events that are associated with flood catastrophes which it is not practicable for him to prevent.

Modern Study of Plants in Relation to Education*

By Prof. E. J. Salisbury, F.R.S.

IF we cast our minds back on the general attitude adopted towards botany in the latter part of the eighteenth century, we cannot but be struck by the almost apologetic phraseology of its votaries and the curious grounds upon which they rationalized its pursuit. Rousseau, for example, described botany as a study of pure curiosity that has no other real use than that which a thinking, sensible being may deduce from the observation of Nature and the wonders of the universe. I venture to think that many otherwise educated people to-day would express similar sentiments, though in more modern and probably less complimentary language.

The teaching of our subject has been in no small degree to blame for the widespread misconceptions as to its aims and content. For long regarded as a harmless and elegant occupation for the female sex, botany only survived as a study of practical utility because of the continued necessity for medical practitioners to acquire some knowledge of *materia medica*. How perfunctory was much of this teaching is indicated in that charming book, "Leaves from the Life of a Country Doctor", where the late C. B. Gann describes how as a medical student in 1878 "the botany class gave me a 'scunner' at the subject which has lasted ever since".

The old technological significance for medicine has long since gone, but a newer and vastly more important significance remains, both cultural and vocational, which has rarely been stated, let alone stressed. Despite the vastly enlarged content of botanical knowledge since those days, the general conception of botany has remained much what it was then. The high value of botany as an educational subject and indeed its absolute necessity in any system of real cultural development are aspects which botanists have failed to present and emphasize.

The protagonists of compulsory Greek and Latin of the last century valued very highly, and rightly so, the cultural content which a study of the humanities could provide. It is easy for us to be wise after the event, but now that the dust of that controversy has cleared away we can see that failure to apprehend that there are other approaches to the same mental salvation led to an unfortunate insistence upon the means rather than upon the end.

But whilst scientific workers justly claim that cultural value is the monopoly of no one subject and that those brought up in the classical tradition may be as much philistines as any man of science, it is undoubtedly true that the immense cultural potentialities of scientific thought have too often been neglected for the sake of mere erudition. There is a general tendency for university teaching to become more and more vocational as the specialized demands of occupations become increasingly exacting. Thus, not only do technological aspects grow more obtrusive, especially in the final courses of certain subjects, but also there is a trend, in the direction of this change, making its influence felt, further and further back in the student's training, so that we find, for example, certain sections of the medical profession demanding that the preliminary education should have a more direct bearing on the future occupation of the student, despite the fact that this can only be accomplished at the expense of their general education and culture. With the long course of training which most professions to-day require and the financial strain that this often involves upon parents, one cannot but sympathize in the wish to provide some relief, but if this is to be accomplished without detriment to the ultimate standing of the professions themselves, it can only be by an increased concentration on the more general aspects of culture in the schools. So far as biology

* From the presidential address to Section K (Botany) of the British Association, delivered at Nottingham on September 2.

is concerned, there is a widespread recognition for the need of greater attention to training in observation in the schools, allied to what may be termed the scientific study of natural history. Too much attention in this as in other subjects is paid to the acquisition of mere information, especially if recent, too little to the principles which are involved.

This is not intended as a stricture upon the teachers, since, with our present system, earlier and earlier in the students' career they are striving to achieve a dual objective—the training which should be their chief concern, and preparation for university examinations at a stage in mental development which cannot adequately appreciate the educational content of the curricula. Thus the student who has taken the intermediate examination from school is often handicapped in comparison with those who would appear to be starting their university career in a less advanced stage.

Just as the increased demand for material things facilitated the replacement of the products of the craftsman by mass production of machine-made articles, so, too, the rapid increase of population following the Industrial Revolution inevitably led to something analogous to mass production in the education of children and the training of teachers.

Many there are who blame the examination system, which, however, with all its faults, if rightly used, is in reality a fairly efficient sieve for separation where large numbers are involved. But the examination machine is often expected to effect a grading of the human material with which it deals that can only be attained by more individual methods. As a consequence, undue importance is attached to examination results and a wrong emphasis is often laid on their significance. This leads to a premium being placed on mere erudition, and so subjects are liable to be taught not as living realities but, in the forceful phraseology used by Winston Churchill in one of his novels, "Knowledge is presented as a corpse which bit by bit we painfully dissect".

Furthermore, our educational methods are, I fear, too often divided in their allegiance; on one hand we aim at the provision of a liberal culture which will make for the greatest happiness of the individual, considered in terms of mental contentment and an abiding resource in later life; whilst on the other hand we aim at the equipment of the student for the earning of his daily bread to ensure bodily comfort. We are not sufficiently trustful that the provision of the former is, to employ the expressive northern phraseology, the "gainest way" to the latter end, and so we adopt a sort of mental squint, which permits neither of the clear vision of the full beauty of integrated knowledge nor even of keeping our eyes on the main chance.

It is no more possible in education than in ethics to serve both God and Mammon. It is not merely good education but the apotheosis of worldly wisdom to seek first the cultural background and to believe that the vocational proficiency will be added unto you.

The universities cannot be held blameless for the lack of appreciation by the general public of the implications of our subject. May I, in this connexion, quote a passage from an American report on university education which loses none of its cogency on this side of the Atlantic: "Appointing authorities too often place undue stress on specialisation, instead of placing adequate emphasis on scholarly background, versatility of intellectual interest and 'general culture'".

Whilst activity and distinction in research is a necessary qualification of the teacher, the capacity to impart knowledge to others is no less essential. Too often in the selection for university posts, aptitude as a teacher, which should be a first consideration, is entirely subordinated to distinction as an investigator. No one, it is true, can be an inspiring teacher who does not possess intellectual initiative and who is not engaged in a creative pursuit, but most of us have suffered at one time or another from the investigator "whose thoughts are too full for words". Furthermore, we must avoid the undue sacrifice of breadth for depth for other reasons.

The accumulation of data and the provision of information bear much the same relation to the advancement of knowledge as artificial fertilizers to crop production. Just as our fertilizers must be properly balanced, so, too, our information must be so correlated and concerted that ignorance in one department does not become the limiting factor in our utilization of extensive data in others. In these days of extreme and increasing specialization, such correlation of effort is becoming more and more important, and it is to the universities, old and young alike, that we must look for the maintenance of that contact and synthesis which is essential to real progress. In particular, I should like to urge that the time has come when the curriculum required of those proceeding to a university degree in science should be reconsidered. It is, in the present state of knowledge, as much an anachronism that a student should be able to proceed to a degree in chemistry having no knowledge of biology as that he should proceed to a degree in botany with a mere smattering of either physics or chemistry. Anyone who aspires to a degree in science should in my opinion have an adequate appreciation of the principles of physics, chemistry, mathematics, especially as regards statistical methods and probability theory, and lastly, but by no means least, one biological

subject. It may be stressed that some biological training is to-day an essential to any liberal culture and should be as much an obligatory part of a school curriculum as arithmetic.

One great merit of botanical study from the point of view of general education is that, if properly taught, it provides perhaps the best medium for training in accurate observation. Observation consists essentially of two separate processes, namely, seeing the object or phenomenon and the apprehension of what is seen. The visual perception of the good and bad observer may be alike adequate, but it is in the degree of their

apprehension that they differ. To train such powers it is essential to check the accuracy of appreciation either by means of verbal description or graphic representation. The graphic method is clearly more suited to the adolescent mind, whose limited vocabulary and limited feeling and understanding of the nuances of meaning of words unduly restricts his verbal precision. Drawing, if regarded strictly as a statement of observed facts, offers the best means of such training, and botanical material, because of its well-defined organization, is peculiarly suited for this purpose.

[To be continued.]

Surface Action in Biology

A JOINT symposium including Sections A (Mathematical and Physical Sciences), B (Chemistry) and I (Physiology) was held on this topic at the recent meeting at Nottingham of the British Association.

Since the development of the Langmuir trough in 1917, several new methods have been introduced into our armoury of weapons used for attacking the problems connected with film structure and film reactions. Of these, two have been developed in some detail and have provided us with numerous interesting and novel results, which appear to have far-reaching biological implications.

In the first method, a number of mono-layers of barium stearate are successively built up on a chromium-plated surface. Brilliant interference colours are observed when the film is viewed at a suitable angle in polarized light, conveniently obtained with the aid of a 'Polaroid' screen. The interference minima are so sharp that increments in thickness so small as 1.6 Å. can be detected. If in the outer layer the divalent barium ions be replaced by ions of a higher valency, for example, thorium, the surface is now 'conditioned' in that it will adsorb monolayers of a variety of substances, for example, proteins or cholesterol. On these surfaces in turn adsorption of a second mono-layer can take place, for example, digitonin on cholesterol but not on epicholesterol. It is found that many of these selective adsorptive reactions are highly specific.

By superimposing instead of a series of barium stearate monolayers, mixed films containing barium stearate and stearic acid are employed, the composite mixed membrane may be leached with stearic acid solvents, and a skeleton membrane of barium stearate remains. Such a skeleton can be refilled with various liquids, and the successful penetration followed by observing the changes in

the refractive index of the layers. By sensitization of such a skeleton film and coating with a mono-layer, it is evidently possible to examine the permeability of adsorbed monolayers to different solvents.

This optical method of examination provides us in the first place with an elegant means of determining whether adsorption has taken place or no, for example, in such reactions as the antibody antigen reaction. If in this case the surface reaction is indeed as specific as the bulk colloid reaction, it is evident that the method may well prove an agreeable substitute for the usual precipitation technique. In respect to sensitivity, we may note that one square centimetre (ample for optical examination) requires only 10^{-7} gm. for deposition. In the second place, the optical examination of skeleton membranes permits us to investigate both their permeability and ease of penetration by a variety of solvents. Since such penetration involves not only considerations of pore size but also of the extents of interaction between the penetrating molecular species and the material of the membrane, it is evidently a convenient method for obtaining information on each of these factors.

The second method of investigation involves determination of the force area characteristics, and the modification in the phase boundary potential caused by the presence of the film. Since in general terms the force area values give us information about the non-polar and the phase boundary potential provides us with knowledge about the polar portions of a complex organic molecule, it has been found possible to make fairly detailed analysis about the orientation of even complex film-forming systems. This applies especially to substances existing in what is termed the homallic state, that is, extended on the surface, such as are found in the protein or cellulosic monolayers.

Since chemical action involves an alteration in the magnitude of the dipole moment of at least a portion of the reacting molecule, this method is found most convenient for following rates of reaction which may involve either an interaction between molecules in the film with those in one of the bulk phases, or interaction between molecules existing in the film itself. In this latter case, a more or less continuous polymeric film can be built up. Such polymeric films present interesting properties in respect to their elastic behaviour when solid and in their viscosity when liquid, and merit detailed examination.

Since in many cases the molecular orientation in the monolayer can be affected by a change in pressure exerted on the film, it is possible to examine the effects of molecular orientation in the kinetics of film reactions. Very remarkable changes in reaction velocity can be effected in some cases by a minute change in the surface tension; furthermore, in photo-chemical reactions in films we can control the extinction coefficient and thus the quantum efficiency of surface photo-chemical action.

In addition to such enzyme and chemical reactions, it is also possible to examine those loose molecular associations frequently termed 'complexes' in some detail. We have already referred to the adsorption of digitonin by cholesterol, and similar reactions are involved with other glucosides such as saponin and even with much simpler molecules. Thus long-chain alcohols, especially secondary alcohols, and long-chain acids, form remarkably stable mixed films, although no ester formation is involved. These complexes involve interaction between both the polar head groups and also between the non-polar chain or ring systems of the reactants. Many of the polar head group interactions can be interpreted in terms of a hydrogen bond, but both dipole - dipole and dipole - ion interactions are also involved. The

film technique also permits us to examine the mechanism of penetration of one molecular species into a monolayer of another, and here again both polar and non-polar portions of each molecular species are involved. It is also possible to examine the anchoring together of a number of molecules in the surface monolayer by a polymeric substance introduced into the substrate, for example, the polyphosphoric acid systems on calcium stearate or tannin on a protein.

The method reveals that these molecular associations involving free energy changes of the approximate order of $\Delta F \approx 10,000$ cal. are extremely common in those relatively complex organic compounds met with in biological fluids, and it does not seem unreasonable to assume that they are actually present in living systems. For example, lipoids and proteins form lipoprotein films possessing interesting properties, and we might anticipate the presence of such lipoproteins in sera containing both proteins and lipoids. We might emphasize the remarkable degree of specificity obtainable not only by a change in the orientation of a polar group, but also by a similar change in orientation, for example, by movement of a double bond in the non-polar portion of the molecule.

Whilst it is possible to examine the polar and non-polar interaction separately by this method, much further work is required before a definite statement as to the actual number of bonds and the individual bond energies involved can be made. This goal is important in that it will then permit us to calculate, as Eyring has pointed out, the absolute reaction rates. But it is at least interesting to note that in a protein 'complex' we are satisfied by this experimental technique that a large number of bonds are involved. The process of denaturation must involve, according to theory, the breaking of a large number to form the activated state for denaturation. ERIC K. RIDEAL.

French Society of Chemical Industry

SEVENTEENTH CONGRESS IN PARIS

UNDER the presidency of Sir Robert Mond, member of the Institut de France, the Société de Chimie Industrielle held its seventeenth Congress and at the same time celebrated the twentieth anniversary of its foundation by the late M. Paul Kestner, between the dates of September 26 and October 3. Arrangements made by various committees presided over by M. J. Gérard, M. J. Bougault and M. G.-J. Painvin, were appreciated by a large gathering of French chemists and about

two hundred and fifty delegates from different countries, including more than twenty from Great Britain. British delegates bearing congratulatory addresses were sent by the Royal Society, the various chemical societies and the Institute of Metals.

After the proceedings had been opened in the large hall of the Maison de la Chimie by the Under-Secretary of State for Commerce, Sir Robert Mond gave an address on the evolution of the

nickel industry, and in the same hall, throughout the Congress, were delivered important addresses on such subjects as the chemistry of silicates, by M. Artigas (Madrid), corrosion of metals, by Prof. W. J. Müller (Vienna), sterols, by Prof. I. M. Heilbron (Manchester), and the influence of fundamental research on daily life, by Dr. I. Langmuir (United States). In the Hall of the Sorbonne, M. Georges Claude gave a two hours' lecture with experimental demonstrations on the part he had played in utilizing acetylene, liquefying gases, separating the rare gases, and an account of his attempts (illustrated by a film) to obtain by pumping cold water from great depths of the sea such a temperature difference as would enable an engine to be worked.

Sectional meetings were held in numerous branches of applied chemistry, and to these contributions were made by the following British chemists: J. Muir, on dyeing of fabrics; Prof. C. S. Gibson, on the production of gold mirrors; Sir Robert Robertson, on some of the work of the Water Pollution Research Board; and Dr. F. S. Sinnatt, on hydrogenation.

At the closing session, the President of the French Republic being present, addresses were given by Sir Robert Mond and others on the history and influence of the Société de Chimie Industrielle, and at this ceremony were presented new honorary members of the Society. These included Prof. F. G. Donnan, president of the Chemical Society.

It will, of course, be readily believed that the occasion was marked by characteristic French ceremonial and hospitality, both official and offered by Sir Robert and Lady Mond, who entertained all the delegates to a banquet. The banquet in the Exhibition will remain in the minds of those who were present on account of the artistic and colourful spectacle afforded by a boat

anchored in the Seine and under the windows of the dining-hall, for from it rose jets of water coloured by internally reflected lights, governed by a manual on which the executant played as on an organ.

Apart from the excursions to works and laboratories, including one to the Palais de la Découverte in the Exhibition, which is surely its most notable feature for a scientific man, a three days' excursion attended by about a hundred members was arranged to Mulhouse, where the founder, Paul Kestner, was born in 1864, and thereafter to Lausanne, where he died early this year. Sir Robert Mond, having by his side M. Emile Dollfus, president of the Société Industrielle de Mulhouse, paid homage to Paul Kestner, describing his career and his achievements in chemical industry, such as his apparatus for dealing with corrosive liquids, his evaporators, his plant for maintaining constant humidity and temperature and his foundation in 1917 of the Société de Chimie Industrielle, mentioning also his award of the medals of the British Society of Chemical Industry and the honorary membership of the American Chemical Society. But he also made mention of the features of his fine personality and helpfulness, by which he is remembered by many in Great Britain. It was pleasing to see Madame Kestner at this celebration. At Lausanne, Sir Robert laid a wreath on Kestner's grave.

During this part of the programme, visits were made to the potash mines of Alsace and the chemical works of Thann and Mulhouse, where the production of various salts of potassium, of heavy acids, of titanium compounds and much else of interest was shown to the visitors.

In all its aspects, this Congress proved both instructive and enjoyable to the many delegates who attended it.

R. R.

Obituary Notices

Prof. M. Maclean

PROF. MAGNUS MACLEAN, emeritus professor of electrical engineering in the Royal Technical College, Glasgow, who died on September 2 last, was born in 1858.

If there was one feature about Prof. Maclean which distinguished him from his academic colleagues, it was his outstanding position in non-academic circles. From a humble beginning in Skye he worked his way to the University of Glasgow and became Kelvin's assistant, lecturer in physics to medical students (1892), and in pure and applied electricity to engineering students (1895), whence he was promoted to the chair of electrical engineering at the Royal Technical College, Glasgow (1899). During this progress, he

showed his love of his native Gaelic language by his writing and teaching of its literature. If, therefore, Maclean was pre-eminent as a "great Highlander", he earned his position; and the same admiration which he earned among his fellow clansmen and islesmen he gained in all his other activities, whether masonic or professional. Indeed, wherever Maclean was seen, he was in high places. Should these remarks appear to under-estimate his scientific work, it should be remembered that it is not easy for an outsider—especially for an Englishman—to appreciate his local influence, no matter whether it be called esteem, hero-worship or what else.

Maclean's appointment to the Royal Technical College preceded the present fine building in George

Street, where his influence and wisdom succeeded in carving out a magnificent suite of laboratories and lecture rooms—and no part of them on the "Box and Cox" principle. For this fine department—probably the best in the kingdom—his successors will ever be grateful.

Although Maclean published numerous papers and books on electrical subjects and practice, he stands out in the memory as a mathematical physicist—indeed the very man whom Kelvin could appreciate. Maclean was extremely loyal to his old chief and to his Alma Mater, and he carried with him to the Royal Technical College the methods and traditions he had learnt in his youth. The autocracy of the department so evident in Scottish and German universities, the restricted outlook, the traditional lecturing to the junior students, together with many traits more closely associated with Kelvin, all showed themselves in his strong personality. It was during his professoriate that the Royal Technical College became affiliated with the University.

As an engineer, the limitations of his surroundings must be borne in mind. Glasgow never was, is not, and possibly never will be, a centre of electrical engineering. In Scotland, electrical engineers are largely agents and factors of English concerns, and there is not the creative atmosphere which is so marked a feature in manufacturing districts. The close band of salesmen would not be primarily interested in local production, and electrical engineering did not flourish like mechanical engineering and shipbuilding. To-day most of the leading electrical engineers in Scotland are Englishmen. Personally, Maclean held a high place in the regard of his electrical associates.

Maclean had high academic distinctions—D.Sc. and LL.D. of Glasgow—the latter honour being conferred on him in 1919, as a leader and a first-rate authority in electrical science, and distinguished alike in the Gaelic language and literature. He was a member of the Institutions of Civil and of Electrical Engineers, and of many of the learned bodies.

In his private life Maclean suffered deep sorrows in the loss of his wife and of two of his sons. He was an elder in the Westbourne Gardens Church, Glasgow. Maclean loved open-air recreation—he was a keen and good golfer and he enjoyed a game of bowls. His death has left a gap which will not be filled.

S. P. S.

Sir Herbert Sloley, K.C.M.G.

THE death is reported from Cape Town of Sir Herbert Sloley, formerly resident commissioner of Basutoland, which took place on September 22 at the age of eighty-two years. His successful rule of the turbulent Basuto, like that of his predecessor Sir Godfrey Lagden, was based upon an intimate knowledge of Sesuto language, beliefs and customs. He was a pre-eminent example of the type to which anthropologists, Sir William Ridgeway and Sir Richard Temple, for example, were accustomed to point when urging upon the Governments of their day the advantages of a training in anthropology

for the administrator of backward races in obviating the long apprenticeship, which had been a necessary foundation of their successful work.

Sir Herbert Sloley was helped by his personal characteristics, but even he went through a long apprenticeship. Nearly the whole of his working life was passed in Basutoland, which under the rule of Sir Godfrey Lagden and himself was transformed from the most disturbed to the model native territory of South Africa, the crowning achievement being the formation of a Native Council, which brought the commissioner and natives into direct touch and co-operation in matters of administration.

Sir Herbert was born in Calcutta on February 4, 1855, and was educated in England at the Greenwich Proprietary School. After a brief period in a bank, he went to South Africa and joined the Cape Mounted Rifles in 1875. He was appointed captain in a native contingent in the Basuto War of 1880–81. Seizing the opportunity to make a career in Basutoland, he became sub-inspector in the Basutoland Mounted Police in 1884, inspector in 1886, assistant commissioner in 1889, and Government secretary in 1898. On the retirement of Sir Godfrey Lagden, who had accepted the office of commissioner of native affairs in the Transvaal, Sloley was appointed resident commissioner in 1900 and held that office until 1916, when he retired and took up his residence in Cape Town.

Dr. A. C. Fryer

WE regret to record the death of Dr. A. C. Fryer, Local Government Board inspector and a distinguished antiquary, which took place suddenly at Bristol at the age of eighty-two years at the beginning of September.

Dr. Fryer was born at Manchester in 1855 and was educated at Queenswood College, Owens College, Manchester, and the University of Leipzig, where he graduated D.Ph. in 1882. On his return to England he was appointed assistant to Dr. Angus Smith, chief inspector of alkali works under the Rivers Pollution Acts. On the death of Dr. Smith, Dr. Fryer was sent to Bristol as inspector of alkali works for south-west England, and continued to hold that office until his retirement in 1920.

Dr. Fryer was a versatile writer, his published work covering a variety of topics, including verse, stories for children and collections of folk and fairy tales from the north of England and the Hartz Mountains. As an antiquary his interests lay mainly in the early Middle Ages. He published many communications dealing with the classification of fonts and medieval monumental effigies in *Archæologia*, the *Archæological Journal* and the *Transactions of the Bristol and Gloucestershire Archæological Society*. He was the author of an illustrated volume on "The Wooden Monumental Effigies in England and Wales", of "Llantwit Major", a fifth century university, and of lives of Cuthbert of Lindisfarne and St. Aidan, the apostle of the North Country. Dr. Fryer was a member of the Advisory Committee for the care of churches of the dioceses of Bristol and Bath and Wells.

News and Views

Sir Harold Carpenter, F.R.S.

At its general meeting in Düsseldorf, Germany, on October 10, the Verein deutscher Eisenhüttenleute awarded its Carl Lueg Gold Medal to Sir Harold Carpenter, while Mr. James Henderson was elected an honorary member of the Association. The Carl Lueg Gold Medal was founded in 1904 to celebrate the uninterrupted period of twenty-five years during which Dr. Carl Lueg had held the presidency of the Association. The last occasion on which the Medal was presented was in 1934, and Sir Harold is the first Englishman to receive the Medal. Sir Harold Carpenter is professor of metallurgy at the Royal School of Mines, Imperial College of Science and Technology, South Kensington, London. From 1898 until 1901 he was a research fellow and demonstrator of Owens College, Manchester; in 1901 he was one of the first to join the staff of the newly founded National Physical Laboratory, being appointed head of the Chemical and Metallurgical Departments. From 1906 until 1913 he was professor of metallurgy in the Victoria University, Manchester. Sir Harold's researches have covered a field too wide for individual mention, but reference may be made to his pioneer work on the determination of the freezing point of iron and the complete iron-carbon equilibrium diagram (in collaboration with B. F. E. Keeling), to his investigations on high-speed cutting tools and other special steels, on the growth of cast-iron on repeated heating and on the constitution of alloys and to his classical researches on the growth of single crystals in metals and their properties. Sir Harold is the great-great-grandson of Henry Cort, the inventor of the puddling process and of the use of grooved rolls for rolling metals.

Mr. James Henderson

HONORARY membership of the Verein deutscher Eisenhüttenleute is likewise a mark of great distinction. Since 1881, when the Association was founded, only sixteen honorary members have been elected. Of these, only one was an Englishman, namely, Sir Hugh Bell, who was accorded that honour in 1910. Mr. James Henderson's enrolment in the list of honorary members of the Association is thus a very high tribute. Born in Glasgow in 1868, Mr. Henderson's first appointment was in the laboratory of the Glasgow Iron and Steel Co., Ltd., at Wishaw. At that time, 1886 roughly, a plant for the making of steels by the basic Bessemer process was being laid down under the supervision of Mr. Maximilian Mannaberg, who had come from Gebrüder Stumm, Neunkirchen. This association with Mr. Mannaberg was renewed when, in 1889, Mr. Henderson moved to Frodingham in North Lincolnshire, where the basic open-hearth process was being developed and where he was to remain for the rest of his active business life. Starting as chief metallurgist, he passed through various departments before eventually becoming

managing director. For forty-five years he has been associated closely with a number of significant developments. The Frodingham Works adopted the Talbot direct metal process as early as 1906; towards the end of the last century experiments began at Frodingham in the use of blast-furnace gas in gas engines and culminated in the installation of one of the first Cockerill (Seraing) gas-engined generating sets: the application of blast-furnace gas to blowing and power engines was continued consistently, and represents to-day a major item of economy at Frodingham: the Appleby plate mills which, on their completion in 1927, represented the last word in plate rolling practice in Europe, were a landmark in Mr. Henderson's term as managing director. He joined the Iron and Steel Institute in 1892, has been a member of Council since 1925, and honorary treasurer since 1934. In September 1936, he officiated as acting president at the Autumn Meeting of the Iron and Steel Institute held in Düsseldorf.

Dr. F. W. Eurich and Anthrax Research

THE Council of the Textile Institute has decided to award its medal to Dr. F. W. Eurich, on the occasion of his retirement from the Anthrax Investigation Board for Bradford and District, to mark its appreciation of his services to the wool industries. The medal was founded in 1919 and has hitherto been awarded mainly for services to the Institute. In 1905 the Home Office, in co-operation with the Bradford Chamber of Commerce, constituted the Anthrax Investigation Board for Bradford and District, and Dr. Eurich was appointed bacteriologist. The investigation involved the bacteriological examination of about 14,000 samples of wool and hair. The virulent nature of the anthrax bacillus was a constant and serious danger to the investigator. Dr. Eurich was the first to cultivate anthrax organisms from the wool. He also found that, contrary to expectation, wools might be as dangerous when clean as when dirty. The infection was through the blood stream of the animals, and the tenacious adherence of the blood serum throughout processing, hitherto unsuspected, was exposed as a significant factor in the problem. Dr. Eurich discovered that many varieties of wool and hair are liable to infection and listed them roughly in order of danger. The nature of the anthrax bacillus, the mode of infection, and the conditions under which it persisted were discovered. With Mr. Elmhurst Duckering, Dr. Eurich succeeded in killing anthrax spores and bacilli in a wool sample with formaldehyde, and this was found to have no deleterious effect on such processes as spinning and dyeing. In addition, Dr. Eurich introduced improved treatment of the disease when contracted, and effectively reduced its fatality. Workers in wool owe a large debt of gratitude to him for his long-sustained work on the dreaded "Bradford disease".

Mr. R. H. Hodgkin

MR. ROBERT HOWARD HODGKIN, who has been elected provost of Queen's College, Oxford, to succeed the late Canon Streeter, had retired from Oxford at the end of last term, relinquishing the position of senior history tutor of Queen's College, which he had held since 1910. Mr. Hodgkin is now in his sixty-first year. He was born at Newcastle-upon-Tyne on April 24, 1877, the son of Dr. Thomas Hodgkin, a banker and distinguished historian of Europe in the Middle Ages. Mr. Hodgkin was educated at Repton, Leighton Park School, Reading, and Balliol College, Oxford, taking first-class honours in the Final School of Modern History. He was appointed lecturer in modern history of Queen's College in 1900; and was University lecturer in modern history in 1928-34. His most considerable contribution to historical literature is his "History of the Anglo-Saxons" (1935), in which the scientific data of anthropology and archaeology are drawn upon to the full to serve the purpose of historical research. Although a member of a distinguished Quaker family, Mr. Hodgkin held a commission in the 1st V.B. Northumberland Fusiliers for some years, and thereupon was obliged to withdraw from the Society of Friends. During the Great War he served as captain in the Seventh Battalion of his old regiment, and on the General Staff (Operations) at the War Office.

Evans' Biological Institute

A COMPANY of some seventy-five medical men attended the Evans' Biological Institute at Runcorn, Cheshire, on October 7, when an extension was formally opened by Lord Derby. In introducing Lord Derby to the company, Mr. T. Edward Lescher directed attention to the fact that the organization known as Evans' Biological Institute is the result of continuous development during the last twenty-five years, and that it originated as a laboratory and farm station in connexion with the Liverpool Institute of Comparative Pathology under the ægis of the University of Liverpool. It was in 1903 that Prof. (afterwards Sir Rupert) Boyce, professor of pathology, and Prof. (now Sir Charles) Sherrington, professor of physiology, together with Dr. H. E. Annett, then lecturer on comparative pathology, conceived the idea of establishing a farm station at Higher Runcorn for the study of comparative pathology. Included in the committee of management was Mr. J. J. Evans, the first chairman of Evans Sons Lescher and Webb, Ltd., and his son Mr. J. H. E. Evans, who is the present chairman of the company. Shortly before the Great War, the University was compelled to relinquish activities at Runcorn, and the laboratories and farm station and laboratory personnel were taken over by the above firm. Although to some extent the activities were restricted during the War and for some years afterwards, valuable work was done and much experience gained. Gradually the scope of the work carried on was extended and accommodation increased, and in 1928 a commodious new building, containing up-to-date laboratories and equipment, was erected. Additional stables were

erected in due course, and this year another new building has been completed.

DURING all these years, the work originated by the Liverpool Institute of Comparative Pathology has been continued at Runcorn along similar lines. A close study is made of the vital processes of living organisms, in the hope of evolving measures for the prevention of disease rather than the introduction of new palliative measures for use in treatment. In recent months the scope of the research work carried on at the Institute has been extended to chemotherapy, as it was discovered in 1935 that it is possible to control streptococcal infections by means of an important new drug intended for use in the treatment of various bacterial infections. The Institute is licensed under the Therapeutic Substances Regulations and thus is intimately linked with the Ministry of Health administration. Under these regulations, practically all the products with which the Institute is associated must maintain a very high standard. It has always been insisted upon that research and production should be conducted on strictly ethical lines, and no consideration has allowed any alteration to this policy. Lord Derby said that he felt it was a privilege to be associated with the opening ceremony, especially as in his office as chancellor of the University of Liverpool he knew those who were originally connected with the work. He looked forward to the research activities of the present staff leading to the introduction of still better ways of dealing with disease.

Historical Relations of Pharmacy and Physic

THE historical relation of pharmacy and physic was the subject of Sir Humphry Rolleston's address at the opening of the ninety-sixth session of the College of the Pharmaceutical Society. He showed how, in the field of medicine, as in most other fields, evolution has brought with it specialization, and that among the roots of the tree of medical knowledge is the legend of Cosmos and Damian, the patron saints whom pharmacy shares with medicine, surgery, barbery and midwifery as evidence of their common origin. The process of decentralization and specialization of medicine has been repeated at very different dates in the world's chronology. In Egypt medical specialism had reached its acme in the fifth century B.C. when every medical man confined his activities to one disease. On the other hand, in Europe it is difficult to trace a distinction between medical practitioners and the representatives of modern pharmacists until the approach of the Renaissance. In Great Britain, the process of specialization and separation was slow and painful. From so early as 1447, the Grocers Company in the City of London had the right of inspecting shops for the sale of drugs, ointments and plasters, and its members were the recognized drug sellers of the day. From the specialist grocer the apothecary developed and in due time became a thorn in the flesh of the physicians, so that in 1540 the Royal College of Physicians obtained the power to "search, view and see the apothecaries' wares, drugs and stuffs". The apothecaries, balancing

between trading and professionalism, temporarily came down on the wrong side of the fence, being united with the Grocers Company by charter in 1606. But this inconvenient marriage was dissolved in 1617, when the Society of Apothecaries obtained its own charter, James I saying that the apothecaries practised an art as well as a mystery, whereas the grocers were merely merchants.

THE apothecaries used their new freedom for still further specialization. They enhanced their reputation by devotion to the sick at the time of the Great Plague and rapidly developed into the general practitioners of medicine, a position ultimately recognized by registration under the Medical Act. They gradually abandoned pharmacy for physic and left the way open for the pharmacist as he is known to-day to take their place. Sir Humphry Rolleston did not follow the progress of specialization in recent years. Had he done so he might have shown how to-day, with the progress of medical science, specialization advances apace in both the medical and the pharmaceutical professions. In medicine, the physician and the surgeon find at their elbow the bacteriologist, the pathologist, the radiologist, the psycho-therapist. In pharmacy, the pharmacologist, the biochemist and the serologist are supplanting the galenical pharmacist. It is well for the patient, for whose benefit alone these 'mechanized troops' take the field, that so far they remain auxiliaries and have not yet displaced the 'private of the line'—the general practitioner and the pharmacist at the corner of the road.

Flints and Flint-Working

A SPECIAL exhibition to remain for three months has been arranged at the British Museum, Bloomsbury, at the head of the main staircase, to illustrate the changes in flint, and the various methods of chipping it into implements. This supplements the permanent series in the Prehistoric Saloon (Case R), and is intended to make the grammar of the subject clear to those with restricted opportunities of observing or collecting specimens. Patina has not yet been scientifically explained, but the examination of its varieties is a necessary step in solving the problem, and attention has been paid to the depths attained by patina on several specimens. Some old pieces have been re-chipped by living practitioners; and among those whose skill is exemplified may be mentioned Mr. J. Reid Moir, Mr. J. H. Sewell of Saskatoon, M. Coutier of Paris and Prof. A. S. Barnes. Some peculiar forms assumed by flints when fractured by man or natural forces are exhibited, and the technical terms used in prehistory are illustrated by typical specimens. Drawings of flaking methods presumably practised in the Stone Age are reproduced from Warren K. Moorehead's "Stone Age in North America", and a special feature is the wood-technique (blows delivered by a wooden baton) which is believed to have been adopted by St. Acheul man, the long narrow flake-scars due to this method helping to distinguish work of that date from the preceding Chelles or Abbeville culture.

Origins of Civilization and the Hittites

THE early history of Anatolia and of the races from which the Turkish people is held to be derived was given due prominence in the communications presented by the numerous foreign members attending the second session of the Historical Congress at Istanboul. In particular, it is stated by the correspondent of *The Observer* in the issue of October 11, much importance was attached to a discussion by Prof. E. Pittard of Geneva of the origin of the early brachycephalic racial type, which, first appearing in Europe in the Mesolithic age, introduced to that continent the domestication of animals and agriculture. He pointed out that nowhere except in the Near East and in the region extending eastwards to Afghanistan were cereals to be found growing in the original wild state, while the same habitat was assigned to the wild prototypes of the domesticated animals. Prof. Pittard then went on to show that a close study of the Hittites indicated that all these elements of civilization were well known to them from early times, this leading to the supposition that we are indebted to this people for their evolution. Recent discoveries and excavations indicate a possibility of demonstrating that Anatolia possessed, just like Europe, a palæolithic period, from which the mesolithic was evolved, and that the remotest origins of civilization may be found in Anatolia. As the views put forward by Prof. Pittard are said to coincide with the point of view of the Turkish Society for Historical Research, it is possible that they will stimulate much-needed intensive study of Hittite origins. It is eminently desirable, however, that this should be extended to include the Caucasus regions to the north of the Hittite area, with which certain of the evidence, especially of philology, appears to indicate a cultural affinity.

Maiden Castle, Dorchester

TWO discoveries are announced at the close of the season's excavation of Maiden Castle, Dorchester, by the Society of Antiquaries and the Dorset Natural History and Archaeological Society under Dr. R. E. Mortimer Wheeler and Col. C. D. Drew. The first is that of a long barrow of remarkable size, no less than eight hundred feet long, overlying the neolithic town, of which the remains have been identified at various points in the eastern part of the site. Evidently the village must wholly, or largely, have ceased to be occupied when this enormous tomb was constructed. Consequently, as is pointed out by Dr. Wheeler, according to a report in *The Times* of October 11, the discovery is of importance. The superposition of the neolithic barrow over the earlier neolithic town will make it possible to classify the successive phases of neolithic civilization in this part of Britain with greater precision than is possible at present, and it will thus afford a standard of chronological comparison for the interpretation of other neolithic settlements and mounds in this part of the country. The second discovery, which was made not far from the point at which the dismembered neolithic skeleton, previously reported, was found, was that

of the grave of a Saxon warrior of the early part of the seventh century. Its importance lies in the fact that the body had been interred with full battle equipment. A *scramasceax* or cutlass-knife lay across the thighs, and two knives and the remains of a spear-head were by the side. The burial is one of the few found in England which include this type of sword, commonly held to be a characteristic weapon of the Saxon tribesmen. The end of this season's work at Maiden Castle closes the fourth and final year's excavation of the site as a joint undertaking by the two societies; and the trenches are now being filled in. Excavation will, however, be continued on a small scale for some time to come.

Population Policy in Germany

WE have received, through the courtesy of Baroness von der Goltz, two papers, written by members of the "Reichsbund der Kinderreichen" of Berlin, dealing with the present population policy of the German authorities, both Government and municipal. These papers are interesting as showing the reasoned approval of the measures taken in Germany in recent years, on the part of many—perhaps of most—Germans who have studied the legislation in question. The first paper is entitled "Birth Policy and the Problem of Space", and is written by Dr. Danzer. The author stresses the view that national existence is bound up with the question of the birth-rate, and that neglect of the obvious tendency in western Europe must lead to disaster. He thinks that the world at large is too apt to consider that Germany is over-populated and that a large population is only desired for imperialistic purposes. He points out that England and Belgium have double the population density of Germany; and he remarks that unemployment is not necessarily caused by overcrowding, as is clearly evidenced by the case of the United States. As to space, the resources of Germany are not exhausted, and the more diligent and efficient a people is, the higher the birth-rate can safely be; and, in any event, it is impossible to lay down a theoretical optimum density, which must vary with varying conditions. He makes the point that there is no instance of the decline of any country being caused by a high birth-rate. In spite of the Great War, it has been found possible to increase agricultural production, so that Germany is now nearly self-sufficient, and only has to import eggs and fats. As to the Colonies, Germany only wants these back as a source of raw materials, and not for population purposes. He ends by saying that the white race is seriously threatened, and that the day will come when every able-bodied white man, German, French, British or Italian, will be asked to save the civilization which they have built up in a millennium.

THE second paper, by Dr. Alfred Moritz, describes briefly the measures which have been taken by national socialism to relieve the economic burdens on the German family. The main purpose of these measures is the support of the financially weak.

Years ago, the Führer said that large, healthy families are the real wealth of the nation. The two-child family is mainly the result of egotism, or lack of courage to take responsibility. The policy of the "Reichsbund" is to relieve parents with at least four children. As is well known, a good deal has been done officially to encourage an increase in the birth-rate, and this policy seems to be meeting with some success. By the law of October 16, 1934, account is taken of the circumstances of those with many children. Thus, a worker with an income of 250 marks a month, with three children, pays no taxes; if unmarried he would pay 30 marks, and so on. Then there is the well-known system of wedding loans of 1,000 marks, the loan being reduced by 250 marks for each child. Then steps are being taken to provide better accommodation for large families; the houses will be provided with gardens, where this is possible. It is considered that, generally speaking, life in the big towns is unhealthy. There is a building programme for five million homes, with gardens, and easy access to the towns. Special financial help for large families is being considered in this connexion, including reduction of train fares; and much else is being done to improve the financial position of parents with large families.

New Form of Saccharimeter

THE saccharimeter, as constructed for many years, differs from the polarimeter in that it contains a system of dextro- and lævo-rotatory quartz wedges between the polarizer and analyser, the adjustment of the wedges replacing the rotation of the analyser. Monochromatic light must be used for polarimetric readings, but with the quartz wedge saccharimeter bichromate-filtered white light can be used since the rotation dispersions of quartz and carbohydrate solutions are almost the same. Until recently it has not been practicable to obtain monochromatic light of sufficient intensity and constancy for use under ordinary laboratory conditions, and the saccharimeter with white light illumination has almost universally been used for sugar analysis. A very satisfactory source of monochromatic light is now obtainable, however, in the form of an electric sodium lamp, and its introduction has led Messrs. Bellingham and Stanley, Ltd., to construct a saccharimeter, without the quartz wedge device, for use with sodium light; the instrument is identical in principle with the polarimeter and differs from the latter only in being provided with a sugar scale, reading from -30 to $+110$ International sugar degrees. This scale, like the angular degree scale of the polarimeter made by the same firm, is etched on a glass circle and, unlike the ordinary saccharimeter scale, requires no magnification; the Vernier attachment, also, is etched on a glass plate. The elimination of the quartz wedge system has several advantages. It obviates any error due to want of optical homogeneity of the quartz, it renders unnecessary the exact adjustment of the temperature of the apparatus to that of the observation tube and the reading is taken, not by reflected, but by transmitted light.

Coloured Light for Motor-Car Headlights

As many motorists use headlights giving coloured lights, an authoritative and scientific statement as to whether coloured light is better than white light for night driving or during fog has for long been desired. A report by an illumination committee of the Department of Scientific and Industrial Research (Technical Paper No. 20. London: H.M. Stationery Office) has now practically settled the question. Adequate evidence is given that in conditions of slight or thick fog the range of visibility of objects seen in the beam of the headlight is not increased by the use of coloured light obtained from the original white light by means of a filter. One investigator has put on record that in clear weather the range of visibility of an object is increased about 6 per cent by the use of a yellow filter. This result was obtained at a distance of about 900 feet; but at shorter distances, at which the motorist is more concerned to see objects, the advantage of the yellow filter, in any event small, is still smaller. There is no experimental evidence that the power of the eye to perceive contrasts of brightness in the presence of a dazzling light is enhanced if similar colour filters are placed over the dazzling light and over the light illuminating the objects viewed. The evidence as to whether the use of coloured light obtained from white light by means of a coloured filter enables the eye to detect contrasts of brightness more easily is conflicting. Recent investigations have shown that there is a slight advantage, but this is inconsistent with the measurements of earlier workers. There is evidence for a slight increase in the power of the eye to perceive the details of a pattern in 'black and white' by the use of yellow light obtained from white light by means of a filter.

Technical Development and Manual Labour

IN a paper read before the Royal Society of Arts on March 17 on "The Displacement of Labour by Machinery" and recently made available, Mr. H. D. Henderson discussed the subject of the effect of technical progress on employment. The contention that invention is now flowing in a direction which merely leads to the introduction of machinery so automatic that scarcely any labour is needed to operate was described as plausible but devoid of substance. The distinction, on which it rests, between mechanization which is in the main co-operative with labour and that which is in the main competitive with it is illusory, since all mechanization diminishes the amount of labour employed per unit of output, while the inventions which have done most in the past to stimulate economic activity have entailed an especially large economy in this respect. He believes that the old economic argument, which sought to prove that technical progress serves in the long run to expand rather than to contract the demand for labour, is still valid. Owing to change in population trends, however, the process of technical development is likely to be accompanied in the future by greater difficulties and more awkward problems of adjustment. These problems cannot be escaped

by slowing down the rate of technical progress, so far as this depends on the extended use of machinery. Such action would only intensify our difficulties while depriving us of the benefits of mechanical advance.

Organization of Human Society

IN his Herbert Spencer Lecture at Oxford on May 27 entitled "Integrative Levels: a Revaluation of the Idea of Progress" (Oxford: Clarendon Press; London: Oxford University Press, 1937. 2s. 6d. net), Dr. J. Needham discusses Spencer's treatment of sociological problems in relation to the evolution of social organizations to meet the needs imposed by mechanization and the impact of science to day. He suggests that a democracy which produces the form of society most in accord with what we know of the biological basis of human common life. Evolution is not yet finished, organization has not yet reached its highest level and we can see the next stage in the co-operative commonwealth of humanity, the socialization of the means of production. Every transition from the unconscious to the conscious implies a step from bondage to freedom from lower to higher level of organization, and Dr. Needham emphasizes that our present civilization is not in a state of stable equilibrium. The enormous advances in scientific knowledge and practical technique have made the economic system of Spencer an anachronism. He is of opinion that nothing short of the abolition of private ownership of resources and machines, the abolition of national sovereignties and the government of the world by a power proceeding from the class which must abolish classes will suit the technical situation of the twentieth century. The organization of human society is only as yet at the beginning of its inevitable triumphs.

Preservation of Salcombe Hill

IT has been agreed between the Rev. J. G. Cornish and the Sidmouth (Devon) Urban District Council that South Down Farm on Salcombe Hill and the adjacent South Combe Farm should be preserved in perpetuity as private open spaces. A similar agreement has been made with Dr. Vaughan Cornish concerning the eight hundred yards of cliff frontage to this property. Dr. Vaughan Cornish has also undertaken to maintain a right of way along the cliff even if falls of cliff destroy the existing path. These engagements have been made voluntarily by the Rev. Cornish and Dr. Cornish, and they ensure that the fields of the Salcombe Regis Valley will be preserved as an open space for all time. The Norman Lockyer Observatory is on the top of Salcombe Hill, and it is gratifying to know that, by one of these generous gifts, the fields on the south side of the road opposite to the Observatory are never to be used for building development.

Further Gifts to Oxford from Lord Nuffield

LORD NUFFIELD has offered £1,000,000 to the University of Oxford (including a site valued at £100,000) for the building of a new college to be devoted to the collaboration, particularly in social

(including economic and political) studies, of theoretical students and practical men of affairs. The site is situated to the west of Oxford between Worcester College and Pembroke College. Two further bequests by Lord Nuffield include £100,000 for the erection and equipment of a new laboratory of physical chemistry and £200,000 for the erection of buildings at hospitals associated with the medical research scheme endowed by him in 1936.

Discovery of Teeth of *Australopithecus*

At the time of going to press, we have received a further communication from Dr. R. Broom, dated October 5, supplementing his letter under this title which appears on p. 681. He writes: "Since the above letter was written two weeks ago, four more teeth of *Australopithecus* have been discovered. Two are teeth of a very aged animal with the crowns almost completely worn off. One of these is a lower premolar, and the other a third left upper molar, but these are of little scientific value. The third tooth is a first upper incisor. Unfortunately, part of the crown is broken off and part of the root, but enough is preserved to show most of the structure. It is remarkably human. The width of the crown is about 10 mm. and the whole length of the tooth probably about 32 mm. The fourth tooth is the beautifully preserved crown of a right third upper molar. It agrees closely with the wisdom tooth of the type, but it is slightly more worn and has fewer corrugations. It probably belongs to the same individual as the third right lower molar tooth."

Announcements

THE Lord President of the Council has appointed Dr. G. M. B. Dobson, Lieut.-Colonel J. H. M. Greenly and Mr. S. K. Thornley to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Prof. A. Fowler, Sir Clement Hindley and Dr. T. Franklin Sibly have retired from the Council upon the completion of their terms of office.

THE first Radford Mather Lecture of the British Association will be given by the Right Hon. J. Ramsay MacDonald on Friday, October 22, at the Royal Institution, Albemarle Street, London, W.1, at 5 p.m. Mr. MacDonald will take as his subject "Science and the Community". The Norman Lockyer Lecture, on "Origins of Town Life in Britain: an Illustrated Review of Recent Evidence", will be given by Dr. R. E. Mortimer Wheeler in the Goldsmiths' Hall, Foster Lane, Cheapside, London, E.C.2, at 4 p.m. on Wednesday, November 24. Further information can be obtained from the Secretary, British Association, Burlington House, London, W.1.

THE Iron and Steel Institute and the Institute of Metals have arranged to hold their 1938 autumn meetings in the United States, opening in New York jointly with the corresponding American Institutes on October 3. Technical sessions will be held on

October 3 and 4, and from then until October 21 visits will be made to various centres of technical interest in the United States. Further information can be obtained from the Secretary, Iron and Steel Institute, 28, Victoria Street, London, S.W.1.

THE Federation of Progressive Societies announces a series of fourteen lectures being given in the Conway Hall, Red Lion Square, W.C.1, at 8 p.m. Among the subjects and lecturers are: November 3, eugenics and the class struggle, J. B. S. Haldane; November 10, sex and censorship, Norman Haire; January 5, 1938, the failure of intellectuals, Dora Russell; February 2, the cultural basis for unity, John MacMurray. Particulars may be obtained from the hon. secretary of the Society, 4 Fitzroy Street, London, W.1.

THE following appointments and promotions have recently been made in the Colonial Service: B. de L. Inniss, agricultural superintendent, Gold Coast; A. B. Lucy, agricultural officer, Malaya; A. F. Posnette, botanist, Agricultural Department, Gold Coast; D. H. Welch, agricultural officer, Nigeria; H. B. Burgess, assistant conservator of forests, Nigeria; J. H. Nelson Smith, assistant conservator of forests, British Honduras; P. R. Pago, assistant conservator of forests, Nigeria; C. L. Turner, veterinary officer, Malaya; G. K. Argles, manager, Fruit and Vegetable Development Scheme, Jamaica; E. G. A. Benson (assistant agricultural superintendent), agricultural superintendent, British Guiana; D. L. Blunt (director of agriculture, Cyprus), director of agriculture, Nyasaland; W. E. Freeman (late tobacco breeding officer, Mauritius), botanist, Agricultural Department, Nigeria; E. F. S. Shepherd (botanist and mycologist, Agricultural Department, Mauritius), plant pathologist, Gold Coast; J. P. Edwards (senior assistant conservator of forests), conservator of forests, Malaya; M. Crawford (Government veterinary surgeon), deputy director (animal husbandry) and Government veterinary surgeon, Department of Agriculture, Ceylon; G. B. Simmins (veterinary research officer), senior veterinary research officer, Department of Agriculture and Fisheries, Palestine; M. A. Crane (chief draughtsman), research officer, Mechanical Engineering Department, Nigerian Railways; C. G. Fannin (district surveyor), chief surveyor, Kenya; J. H. Halebian (assistant chemist), chemist, Department of Antiquities, Palestine; A. S. McKinnon (assistant livestock officer, Veterinary Department, Tanganyika), agricultural officer, Veterinary and Agricultural Department, Somaliland; J. H. Nield (computer), district surveyor, Kenya; J. G. Reece (first assistant surveyor), deputy surveyor and deputy sub-intendant, Trinidad; H. Smith (assistant mechanical engineer, Public Works and Electricity Department, Zanzibar), inspector of machinery, Mines Department, Gold Coast; J. A. R. Stoye (Government analyst, Mauritius), assistant Government analyst, Nigeria; W. G. W. Wilson (superintendent of workshops), chief mechanical engineer, Nigerian Railways.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 685.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Discovery of a Lower Molar of *Australopithecus*

ABOUT a year ago I announced the discovery of a new specimen of a fossil anthropoid from a cave at Sterkfontein, near Krugersdorp, Transvaal. The specimen consists of the nearly complete brain cast, most of the base of the skull, with both maxillae in fair preservation. Of the teeth we have on the right side the second premolar and the three molars, and on the left side both premolars and the first and second molars. In addition we have the socket of the right canine, and those of the left canine and both incisors fairly well preserved. It is thus possible to make a satisfactory restoration of the whole upper dentition.

I referred the ape to a new species of *Australopithecus*; as though certainly allied to the Taung ape it is evidently considerably later in time. Owing to the great importance of *Australopithecus* as a fossil anthropoid with teeth much more like those of man than those of any of the living anthropoids, and to its thus possibly being nearly related to the anthropoid from which the human stem arose, it seems necessary to get as much new light on this remarkable form as we can.

Explorations of the Sterkfontein cave and of other caves in the neighbourhood have resulted in a satisfactory knowledge of the animals that were contemporaneous with *Australopithecus transvaalensis*, and the fauna shows that the climatic conditions were probably not unlike those of to-day. A full account will be given elsewhere of the associated fauna. It seems to be of Upper or possibly Middle Pleistocene age.

On September 15 I was fortunate in discovering a beautifully preserved third lower molar of *Australopithecus*. As fossil anthropoids are better known by their lower molars than the upper, it was felt that we could scarcely decide the affinities of the ape until we got a lower jaw or at least a good lower molar. The tooth was quite isolated. It is from the same cave as the skull and from about the same level but from a spot about six yards from the other. It cannot, I think, belong to the same individual, but it is the tooth of a young adult, not improbably a male. The crown is slightly worn.

The tooth is very large, the greatest antero-posterior length of the crown being 17.7 mm. and the greatest breadth 15.2 mm. It is thus comparable in size with that of the gorilla and very much larger than the corresponding teeth in the chimpanzee or man. The crown pattern will be seen from Fig. 1 to be a modification of the well-known *Dryopithecus* pattern. There are three large cusps on the outer side, and three almost as well developed on the inner side. As will be noted, there are clear indications

of a rudimentary external cingulum such as we find in *Dryopithecus*, and in the small fossil anthropoids, *Bramapithecus* and *Sugrivapithecus*, recently discovered by Lewis in the Siwaliks. Indications of the cingulum are usually seen in the molars of the gorilla, but they are usually lost or only represented by pits in the chimpanzee and man. There is a well-marked anterior fovea—a characteristic generally present but not much developed in the gorilla. A fovea is often present in man, but is usually lost in the chimpanzee.

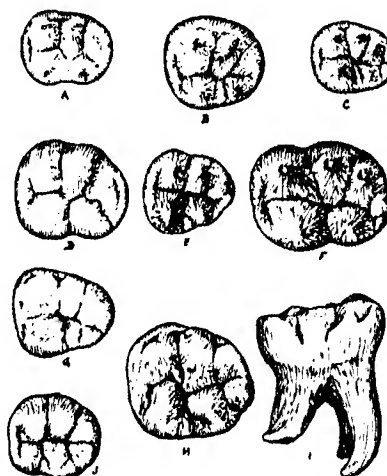


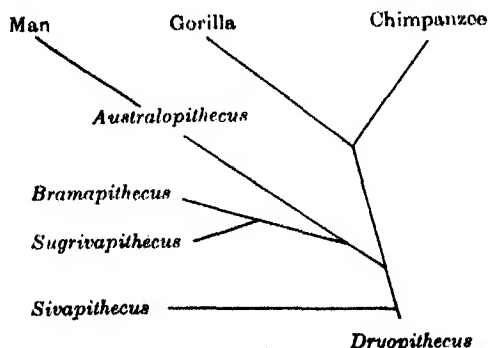
Fig. 1.

THE THIRD RIGHT LOWER MOLAR TOOTH IN *Australopithecus transvaalensis* BROOM, AND IN ALLIED ANTHROPOID APES AND MAN. ALL FIGURES NATURAL SIZE.

A. *Dryopithecus fontani* Lartet; B. *Dryopithecus darwini* Abel; C. *Dryopithecus rhenanus* (Pohlig); D. *Dryopithecus chinjiensis* Pilg. (= *vide* Lewis *Sivapithecus indicus*, Pilg.); E. Chimpanzee; F. Gorilla; G. *Bramapithecus punjabicus* Lewis; H. *Australopithecus transvaalensis* Broom (occlusal surface); I. *Australopithecus transvaalensis* Broom (outer view); J. Australian native woman. All figures except G, H and I are after Gregory, a number reversed.

From the illustrations it will be seen that the tooth in its crown pattern agrees more closely with that of an Australian native than it does with that of any of the known anthropoids. It may be regarded as a form evolved from that of *Dryopithecus*; the molar of man may be regarded as derived from that

of *Australopithecus*, but reduced in size and degenerate. The molars of the gorilla and chimpanzee are probably evolved from a pre-*Australopithecus* type.



All the available evidence would seem to indicate that the higher anthropoids and man may be related as shown in the accompanying diagram.

R. BROOM.

Transvaal Museum,
Pretoria,
South Africa.
Sept. 21.

Detection of α -Particles in the Disintegration of Thorium

THE nuclear process ($n\alpha$), that is, the expulsion of an α -particle by a neutron, has hitherto been observed only for light nuclei; it probably takes place also in the case of heavy, unstable nuclei. Hahn, Meitner¹ and Curie, v. Halban and Preiswerk² assumed the reaction ${}^{232}\text{Th} (n\alpha) {}^{228}\text{Ra}$, and the existence of the radium isotope was established by the latter three by chemical identification.

We have made an attempt to detect directly the presence of these α -particles, which we expected to be of high energy. We used an ionization chamber in conjunction with a linear amplifier. When thorium was bombarded by neutrons from a radium-beryllium source, α -particles were detected, which must be ascribed to the reaction ${}^{232}\text{Th} (n\alpha) {}^{228}\text{Ra}$. Preliminary measurements with absorbing screens have shown that these α -particles possess an energy greater than 9 million electron volts.

A full account of these experiments will appear in due course in *Helv. phys. Acta*.

A. BRAUN.
P. PREISWERK.
P. SCHERRER.

Physikalisches Institut,
Eidgenössische Technische Hochschule,
Zürich. Aug. 31.

¹ Hahn und Meitner, *Naturwiss.*, **22**, 320 (1935).
² Curie, v. Halban und Preiswerk, *C.R.*, **200**, 1841 and 2079 (1935); *J. Phys.*, **6**, 361 (1935).

Production of Showers by Heavy Particles

Carlson and Oppenheimer¹ and Bhabha and Heitler² have proposed a very ingenious explanation of showers by a multiplicative production of photons, electrons and positrons. The greater part of the showers observed can in this way be regarded as originated by electrons, positrons or photons penetrating from the atmosphere. Such showers are absorbed if the layer of lead is sufficiently

thick. It is known, however, that at sea-level and especially under earth, the frequency of showers with increasing thickness of lead layer does not diminish but tends to a limit. We wish to point out that this phenomenon does not require a new concept of showers, but can be explained by irradiation with heavy particles, which easily penetrate through such layers of lead.

A more rigorous treatment of showers³ shows that a shower has a certain range given by the formula

$$L = 0.25 \frac{\hbar c}{e^2} \left(\frac{mc^2}{e^2} \right)^2 \frac{1}{ZN} \log \frac{E}{e},$$

where \hbar , c , e have the usual meaning; m is the electronic mass; N is the number of electrons per cm.²; $Z = \frac{\sum N_s Z (Z+1)}{\sum N_s Z}$ (N_s is number of atoms with charge Ze); E is the energy of the incident particle and e a critical energy of the order of magnitude 750/ Z million volt.

If we combine this formula with the well-known formula for radiation probability for a heavy particle, we get for the probability that a shower produced by a photon emitted by a heavy particle gets out of the layer of sufficient thickness:

$$W = 0.8 \left(\frac{m}{M} \right)^2 \left(\log \frac{E}{e} \right)^2 \log \frac{E}{(Mc^2)^{1/2} e^{1/4}};$$

where M is the mass of the heavy particle and E its energy, which is assumed $\gg Mc^2$. If we take for M the value of some tens of electronic mass proposed by Anderson and Neddermeyer⁴, we get a fair agreement with the observed order of magnitude.

Details of the calculations will be published elsewhere.

L. LANDAU.
G. RUMER.

Physical Institute,
Academy of Sciences of the U.S.S.R.,
Moscow.
Sept. 1.

¹ *Phys. Rev.*, **51**, 220 (1937).

² *Proc. Roy. Soc. A*, **159**, 432 (1937).

³ *Phys. Z. Sowjetunion*, in the Press.

⁴ *Phys. Rev.*, **51**, 887 (1937).

The Zodiacal Light at a Total Solar Eclipse

AN interesting observation made by Mr. M. Honda in Hokkaido at the total solar eclipse of June 19, 1936, has just been reported and is well worth mention.

Seated in a lightproof bag, which covered his head also until totality had commenced, Mr. Honda observed the sky round the sun, with a large black disk blotting out an area of radius about three solar diameters with the sun at the centre. He saw and plotted the boundaries of the band of zodiacal light from close to the sun, where it had a width of 44°, along the ecliptic to a point about 40° away where it was cut off by clouds. To see the zodiacal light, on what is effectively a moonlit sky, is difficult, but the band must be very much brighter near the sun. Mr. Honda's observation is well worth repeating by other experienced zodiacal light observers at the next eclipse, and if possible some quantitative measure of the intensity of the band should be obtained along with measurements of coronal intensity.

F. J. M. STRATTON.

Solar Physics Observatory,
Cambridge.

Excretion of Nitrogen by Leguminous Plants

WITH reference to Prof. P. W. Wilson's communication upon this subject¹ I wish to make the following comments.

In our laboratory, where the excretion of nitrogen compounds from the leguminous root nodules has been for the first time definitely proved with a sterile culture system, hundreds of experiments have been carried out during the last ten years. In all experiments—both in sterile and in ordinary pot cultures—distinct excretion has practically always been detected, when suitable bacterial strains have been used for inoculation of red clover, white clover and pea, and the experimental conditions have been natural. Our experiments have not been restricted only to sand cultures, but similar experiments have also been carried out in clay and sandy loam soils, in kaolin medium, etc. The excretion of nitrogen compounds from the root nodules is therefore no incidental phenomenon which would appear only under certain artificial laboratory conditions. On the contrary, it occurs in experiments carried out under most natural conditions.

When Prof. Wilson could find no excretion in his numerous experiments during three years and now at last finds the phenomenon occurring in certain experiments, in others not, his experimental conditions must in some way differ from the natural ones. So far as is known to me, Prof. Wilson is using very coarse quartz sand as the substrate and the pot cultures are watered many times a day. According to our investigations the excretion depends greatly on the absorptive capacity of the medium. For example, with water cultures as well as with those containing glass beads, we have as a rule not been able to show any distinct excretion. Nor can any noticeable excretion be expected if the quartz sand particles are big.

From cultures grown on such media no conclusions can be drawn with regard to practical agriculture. Our experiments have been carried out partly in very fine quartz sand, which has a great absorptive capacity, partly in different soils. On the basis of these experiments, and particularly of those carried out in soil, it can be definitely concluded that the excretion is a phenomenon which must occur in the field and plays an important part in practical agriculture. The benefit to non-legumes in associated cultures with legumes, a fact which has been known in practical agriculture for thousands of years, has been explained through the excretion phenomenon. I refer to our publication concerning the associated cultures appearing in the October issue of the *Journal of Agricultural Science* and also to my paper presented before the Fourth Agricultural Grassland Congress at Aberystwyth in July this year.

The extent of excretion varies considerably even in parallel experiments and depends, as I have often emphasized, on many factors, of which so far only a part is known to us. Such factors are, for example, bacterial strain, amount of nodules, host plant, medium and nitrate content of the medium².

At least with the plants employed by us, the excretion can always be shown, and with our recent knowledge of the factors effecting the excretion. In associated cultures of lucerne and rye-grass, Thornton and Nicol (1934), in Rothamsted have detected distinct excretion. If some species of legumes (for

example, soy) should differ in this respect, it certainly does not mean that the excretion phenomenon has no importance in agriculture. However, I consider that, even with soy, thorough investigations must first be carried out using different bacterial strains in inoculating different species of soy and natural media, before anything definite can be stated.

ARTTURI I. VIRTANEN.

Biochemical Institute,
Helsinki.
Aug. 31.

¹ NATURE, 140, 154 (1937).

² See *J. Agr. Sci.*, July 1937.

A PREVIOUS communication¹ referred to experiments with inoculated soybeans (variety "Manchu") growing under normal conditions in sand culture, in which I was unable to detect any excretion of nitrogenous substances from the nodules into the rooting medium, as demonstrated by Virtanen² and his collaborators in other legumes, especially the pea. Further experiments, in which the sand from the culture pots was submitted to direct Kjeldahl analysis without previous drying, have also yielded negative results. The maximum difference between nitrogen contents of the sand from inoculated and control pots was only 2.5 mgm., after four months' growth, during which time 350 mgm. of nitrogen was fixed within the nodules of the five plants of the inoculated pot. Barley plants grown in the same pots as nodulated soybeans derived no benefit from the association, confirming the absence of excretion. Three different strains of bacillus have been tried, including two of the most efficient in fixation from the Wisconsin collection, all with negative results. It is therefore clear that certain measurements of fixation and transfer of nitrogen made in a previous investigation³ under similar growth conditions are complete in themselves and do not require amendment.

Negative results have also been obtained with broad bean (*Vicia Faba* L.) variety "Longpod", both from sand analyses and from examination of test plants grown with the nodulated beans. The fixation here amounted to 275 mgm. for two plants.

It is impossible to say at present whether these negative results arise from the absence of excretion from these particular legumes under any conditions, or from the lack in the present experiments of certain undefined conditions necessary for excretion to proceed. Ludwig and Allison⁴ and Wilson⁵ have also been unable to find excretion in a number of legumes. The plant cultures of the present experiments were not strictly sterile in the sense that some of Virtanen's were, but since the latter author finds excretion in both sterile and ordinary open cultures, it is clear that absence of complete sterility is not a reason for negative results. It is possible that differences in anatomical details of the outer nodule tissues may account for any variations in excretion between different legumes that may finally be established.

With the pea (*Pisum sativum* L.) variety "Gradus", we have obtained a maximum excretion of 7 mgm. nitrogen per pot of three plants, the fixation being 60 mgm. (bacillus strain Virtanen HX). Barley

plants associated with similar peas showed no measurable uptake of nitrogen, confirming that the excretion was small.

Mr. J. Boyes collaborated in some of this work.
G. BOND.

Dept. of Botany,
University,
Glasgow.
Sept. 10.

- ¹ Bond, *NATURE*, 139, 675 (1937).
² Virtanen, *J. Soc. Chem. Ind.*, 54, 1015 (1935).
³ Bond, *Ann. Bot.*, 50, 559 (1936).
⁴ Ludwig and Allison, *J. Bact.*, 31, 93 (1936).
⁵ Wilson, *NATURE*, 140, 154 (1937).

Attitude and Concealing Coloration

I FOLLOWED with much interest and amusement a controversy in *NATURE* concerning the origin of species, which involved the meaning of protective coloration in insects. One correspondent asserted that insects placed themselves in special locations with which their concealment devices blended. I am submitting a further example of this.

We have in New Zealand a tree-lily or palm-lily, *Cordyline australis*, related to the dragon-trees, and known to us as the cabbage-tree. A looper caterpillar lives in and on its green erect crown, and the moth, *Venusia verriculata*, from this caterpillar lies concealed by day in the dead, strap-like leaves that hang like a rustling skirt around the trunk.

Other observers have noted that whenever they have found the moth thus at rest, it was so oriented on the leaf that its brown parallel markings lay along the parallel veins of the dead monocotyledonous leaf. But last summer I was lucky in finding so many on one particular tree that I could stir them up with a straw, and observe that whether they flew or just crept to another leaf, they always, after a few compass-like vacillations, lay down finally with the body across the leaf, so placing wing-lines along leaf-veins. The body is pressed very close, and the antennae bent in under the forewings. The moth in the photograph (Fig. 1) was coaxed on to a length of leaf, and moved into a pre-focused position. It has not closed its wings quite as perfectly as usual, but it can be seen that their lines would otherwise be continued straight across thorax and abdomen and just about parallel with the leaf-veins, which they match very well in colour.



Fig. 1.

Venusia verriculata RESTING ON DEAD LEAF OF THE 'CABBAGE TREE'. APPROX. $\frac{2}{3}$ NATURAL SIZE

This is, so far as I can find, the first time the actual movement, appearing strikingly purposive, has been observed, or even the live insect photographed more or less *in situ*.

J. J. S. CORNES.

Dominion Laboratory,
Scientific and Industrial
Research Department,
Wellington.
Aug. 5.

THE part played by living insects in adopting attitudes which increase the effect of the colour and pattern is often overlooked in discussing the relation of coloration of insects to natural selection. Mr. J. J. S. Cornes has given a striking new example from New Zealand of a phenomenon recorded by Mr. A. H. Hamm¹, for English moths when resting on the bark of trees. It was recorded that the vast majority of the individuals of the common winter moth, *Hybernia leucophaea*, rest with the body horizontal, so that the lines of pattern on the wings are brought into parallelism with the dark shadows in the abundant vertical cracks of the bark on which they rest. If the wings were spread horizontally, as is so often the case with moths of this group, the main lines of the pattern would cut across the main lines of the background.

The same principle was shown to apply to the resting attitudes of other species in a later paper². It is quite obvious when one witnesses such a case that the insect is under the influence of a strong instinct and that until it has adopted the attitude described it is uneasy. The same thing has often been noted with the butterfly *Eronia cleodora* in Africa, of which the underside resembles the blotched green, yellow and brown appearance of a partially dead leaf³. Specimens disturbed from rest among vegetation have been seen to settle among the leaves on a plant which show the same mottled coloration rather than among healthy and entirely green leaves.

G. D. HALE CARPENTER.

Department of Entomology,
University Museum,
Oxford.

¹ *Proc. Ent. Soc. Lond.*, p. xv (March 19, 1902).

² *Trans. Ent. Soc. Lond.*, 483-85, Plate xxix (1906).

³ Longstaff, G. B., "Butterfly Hunting in Many Lands" (London, 1912), p. 194 and frontispiece.

Excretion of Vitamin C in Sweat

ON the Witwatersrand gold mines, where the Bantu mine labourers work under hot humid conditions, cases of scurvy and sub-scurvy occur with some frequency, despite the fact that the diet provided has been shown to contain adequate amounts of vitamin C (some 20-30 mgm. daily). The explanation given is that the high energy requirement increases utilization of the vitamin. However, on testing sweat samples collected from recruits undergoing a 'heat tolerance' test under conditions approaching those encountered underground (shovelling gravel at 97° F. dry and 96° F. wet bulb for one hour in a surface chamber), it was found that sweat reduced indophenol dye under conditions regarded as specific for the vitamin¹.

The vitamin C content of a series of samples varied between 0.5 mgm. and 1.1 mgm. ascorbic acid per 100 c.c. Since the average weight loss during the test is about $\frac{1}{2}$ lb., representing chiefly sweat loss, excretion of vitamin C by this route amounts to some 2 mgm. per hour. Further, examination of the urinary excretion of vitamin C both before and after the heat chamber shows no change. Hence severe exercise produces an increased elimination through the sweat mechanism.

We found² that the average urinary excretion of Bantu miners was 10 mgm. vitamin C daily and did not differ from boys resting. As Orenstein³ has shown that a miner may lose 2½-5 lb. weight after

an eight-hour shift underground, excretion of vitamin C through sweat must play an important part in vitamin C subnutrition in miners, who cannot afford a liberal diet (20–25 mgm. vitamin C daily has been regarded as the indispensable minimum to prevent subscorbic symptoms under normal conditions⁴).

R. E. BERNSTEIN.

Department of Physiology,
University of the Witwatersrand,
Johannesburg.
Sept. 16.

¹ Emmerie, A., and van Eekelen, M., *Biochem. J.*, **28**, 268, 1158 (1934); **30**, 25 (1936).

² Bernstein, R. E., and Weiner, J. S., *S. Afr. J. Med. Sci.*, **2**, 37 (1937).

³ Orenstein, A. J., *Africa*, **9**, 218 (1936).

⁴ Helmemann, M., *Biochem. J.*, **30**, 2209 (1936).

Hexaco-ordination of Tellurium, Molybdenum and Tungsten

THE Raman spectra of telluric acid and several molybdates and tungstates have been examined in the crystalline state and in aqueous solutions, particular care being taken to record their complete Raman spectra. Some of the results are given below :

Telluric acid solution— Δ 644(10), 619(1), 533(3).	
Ammon. molybdate crystals—927(7), 881(4), 862(1), 223(2).	
" "	solution (ammoniacal)—895(5), 820(2), 326(3).
Potass. "	(alkaline)—891(10), 823(3), 319(8).
Sodium tungstate "	(alkaline)—929(5), 834(1), 320(3).
Potass. tungstate "	" —924(4), 835(1), 320(3).

(Figures in parenthesis indicate relative intensities, estimated visually).

In contrast with the results for sulphates¹ and selenates² (and of solid ammonium molybdate), the total number of Raman lines in each of the spectrograms of aqueous solutions is *three*, and *not* four, which is the number of lines expected from a tetrahedral molecule. On the other hand, the relation $\nu_1^2 = \nu_2^2 + \frac{1}{2} \nu_3^2$, which is the relation between the frequencies of an octahedral molecule, is strikingly obeyed, the deviations (2 per cent for molybdate; 0.1 per cent for tungstate) being very much less than what has been observed in some accepted octahedral molecules like the hexafluorides of sulphur, selenium and tellurium³ (10–17 per cent). The intensity relations of the lines are also in agreement with an octahedral structure.

It is therefore concluded that, like telluric acid, the molybdates and tungstates, which are known from studies of the phase systems to exist at ordinary temperatures as dihydrates⁴, are octahedral units in aqueous solutions, two oxygen atoms being co-ordinated to the central atom from the two water molecules of hydration.

A detailed discussion of the subject will be published elsewhere.

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¹ Nish, *Jap. J. Phys.*, **7**, 3 (1932).

² Ganesan, *Proc. Ind. Acad. Sci.*, **1**, 156 (1934).

³ Yost, Steffens and Gross, *J. Chem. Phys.*, **2**, 311 (1934).

⁴ Funk, *Ber.*, **33**, 3700 (1900).

Points from Foregoing Letters

DR. R. BROOM reports the discovery of a molar tooth having the characteristics of *Australopithecus* in a cave at Sterkfontein, South Africa, a few yards from the recently found skull belonging to the same species. The author gives diagrams comparing this tooth with the third right lower molar in allied anthropoid apes and in man, and submits a diagram of a possible relationship between man and the higher anthropoids.

By bombarding thorium with neutrons from a radium beryllium source, A. Braun, Dr. P. Preiswerk and P. Scherrer have detected alpha particles of energy greater than nine million electron volts, which they ascribe to the transformation of thorium of mass 232 into radium of mass 230.

The frequency of ionizing showers at sea-level and under the earth does not diminish with increased thickness of protecting lead, but tends to a limiting value. Dr. L. Landau and G. Rumer suggest that this is due to heavy particles which penetrate easily through lead. They submit a formula for the probability that a shower produced by a photon emitted by a heavy particle gets out of a layer of sufficient thickness, and this, they state, gives fair agreement with observed data.

Commenting on a previous communication by Prof. Wilson on nitrogen excretion by white and red clover and pea, Prof. A. I. Virtanen states that his experiments were carried out in very fine sand and in various soils approximating to natural conditions. He explains Prof. Wilson's failure to confirm the excretion as possibly due to the use of coarse quartz sand, which lacks absorptive capacity. A number of other factors, such as bacterial strain, amount of

nodules, host plant, medium and nitrate content of the medium also affect the amount of nitrogen excreted. Dr. G. Bond now reports experiments with sand cultures of inoculated soybeans which failed to show that nitrogen is excreted from their root nodules. This may be due, he thinks, to lack of as yet undefined conditions necessary for excretion. A small excretion of nitrogen in the case of a pea culture was observed.

In connexion with the discussion on protective coloration in insects, J. J. S. Cornes submits a photograph of an Australian moth, *Venusia verriculata*, resting on a dead leaf of the palm-lily, *Cordyline australis*, with its wings so oriented that their brown parallel markings lie along the parallel veins of the dried palm leaf, which they match in colour. This position they always take up. Prof. G. D. Hale Carpenter recalls a similar phenomenon recorded by Mr. Hamm in the case of the common winter moth, *Hybernia leucophaea*, and another in the case of the African butterfly, *Eronia cleodora*.

The amount of vitamin C excreted in the sweat in the case of Bantu labourers working at a temperature of 96–97° F. in the Witwatersrand gold mines is 0.5–1.1 mgm. per 100 c.c., or about 2 milligrams per hour, according to R. E. Bernstein. This loss of vitamin C may account for the relative frequency of scurvy or sub-scurvy amongst those miners.

The Raman spectra of aqueous solutions of telluric acid and of several molybdates and tungstates show only three lines, and their characteristics indicate that these substances exist at ordinary temperature as dihydrates in octahedral units, two oxygen atoms being co-ordinated to the central atoms from the two water molecules of hydration.

Research Items

Pomo Culture

A FURTHER statistical study of cultural elements among the Indians of California by Mr. E. W. Gifford and Prof. A. L. Kroeber deals with the Pomo as a whole (*Univ. Calif. Pub. American Archaeol. and Ethnol.*, 37, 4). The Pomo form a nationality speaking recognized related languages, or dialects, and are mainly distinguished by directional terms, such as 'south', 'eastern', etc. They are divided into a number of small groups, which, at one time or another, have been called tribes, villages, village-communities, or tribelets. Each was completely autonomous and possessed a main settlement, or central village, ordinarily in some valley, which was the residence of the chief or chiefs. Here was also situated the earth-lodge or dance-house, around which all the community gatherings centred. There was no Pomo culture, except as an ethnological abstraction; but there was a series of highly similar, but never quite identical, Pomo cultures, each carried by one of the independent communities. The aim of the present study is to discover how far the elements of this series, within the framework of a nationality, varied and how they were related. The number of communities is estimated to have been seventy-five; but in all probability this figure is too high. The number may have been about fifty, with an average population of possibly two hundred. The data for statistical treatment comprised 15,000 comparable factual items. From their analysis it emerges that generally it would appear that there existed a high level of uniformity between adjacent minimal territorial entities. The generic picture of Pomo culture accords with a numerical finding of around ninety-five per cent of cultural uniformity ordinarily shared by strictly neighbouring communities. All this presupposes a population always narrowly localized, as well as ordinarily peaceful—as we know it to have been.

Radiation and Cell Division

THE work of Spear has shown that the first effect of small doses of gamma rays on chick fibroblasts in tissue culture is an inhibition of cell division due to an action on the early phases of this process. A paper by Tansley, Spear and Glücksmann (*Brit. J. Ophthalmol.*, June 1937, p. 273) has extended the observations to a mammalian tissue (rat retina) and has presented much additional evidence as to stage of cell division at which the effect occurs. This tissue was chosen because it is still undifferentiated, and actively dividing, for some days after birth, and because it is easily accessible to radiation. Exposure to a small dose causes a diminution in the number of cells in the prophase of division, which reaches a minimum in a little less than two hours. This is followed by a minimum, first of the number of cells in metaphase, and then of those in telophase. If the dose is very small, the counts then rise to maxima which may be greater than the normal value, probably because cells which would have divided during the inhibitory period are added to cells which would have divided in this later period. When the dose is increased, this maximum does not occur and the

proportion of degenerate cells increases. A further increase of dose delays the onset of degeneration. These observations confirm the view that the effect is on the very early stages of cell division, and elucidate an apparent anomaly in connexion with degeneration. If observations had been confined to twelve hours after exposure, an increase of dose would have appeared to diminish the amount of degeneration.

Control of Nematodes of Horses and Sheep

CONTINUING his studies of the control of bursate nematodes, I. W. Parnell has tested the lethal effects of ten of the more common nitrogenous artificial fertilizers upon the free-living stages of sclerostomes (*Canadian J. Res.*, 15, 127, July 1937). The three nitrogenous fertilizers which lost most ammonia when mixed with faeces were found to be most deadly—pure ammonia water has already been shown to be lethal. In general it was shown that the proportion of fertilizer to faeces necessary to effect sterilization would, in farming practice, be too high to be used if all faeces had to be treated. But in a well-built manure heap only the bottom and outer surfaces of the heap would have to be treated, for sclerostome larvae are unable to survive the heat of fermentation, associated probably with lack of oxygen and harmful products of decomposition, in the centre of a manure heap.

Amphibia of Connecticut

IN order to help teachers and students, biologists in schools and colleges, and the plain naturalist, the State Geological and Natural History Survey has published a popular bulletin describing the Amphibia of Connecticut (Conn. State Geol. N. H. Survey, Bull. 57, 1937, pp. 50). The State harbours ten species of frogs and toads, nine species of salamanders and newts, and a few species have been introduced, including *Necturus maculosus*. The bulletin describes each species, indicates its distribution, and gives a short account of its habitat and habits. Identification is simplified by a key to characters and by twenty plates of uncoloured photographic reproductions.

Parasitic Copepods of the North Sea and Baltic

G. M. VAN OORDE-DE LINT and J. H. Schuurmans Stekhoven, jun., give a good account of the parasitic copepods in this most useful series (*"Die Tierwelt der Nord- und Ostsee"*, 31, Teil X.c. Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936). Fish parasites are specially dealt with, and a large number of these have been recorded from the area covered. Dr. Stekhoven has recently described several parasitic copepods from the Belgian coast (*J. Bull. Mus. Roy. d'Hist. Nat. Belgique*, 1936) and worked at the physiology of *Lepeophtheirus*, *Acanthochondria* and *Lernaeocera*: a large amount of work has also been done by other authors on this favourite group. The copepod family Calanidae is the only one without parasitic species. Even the Harpacticoidae include, according to Sars, a species probably parasitic for part of its life on whales, although it is not recorded from the area. A useful register of species, 214 in all,

and their hosts, both vertebrate and invertebrate, occupies thirteen pages, showing the parts of the body parasitized. Of the invertebrate hosts the Mollusca, especially nudibranchs, are the most numerous, Crustacea coming second, and there are a few in or on annelids, echinoderms and tunicates. This section of "Die Tierwelt" will be very useful for reference to those working on the group. It is well and clearly written, and the illustrations are numerous and well chosen. The same part includes Decapoda (Nachträge und Berichtigungen) by H. Balss (X.h.3), and *Pantopoda* (2 Nachtrag) by H. Helfer (XI.a.3).

Ciliary Currents on Lamellibranch Gills

MR. ALASTAIR GRAHAM makes some interesting observations on the gill currents of certain members of the Tellinacea (*Proc. Roy. Soc. Edin.*, 57, Part 2, No. 8). He has noted previously that the outer gill of *Solecurtus scopula* is peculiar in the absence of a groove along the free edge which is usually present in lamellibranchs. He has also shown (1934) that *Solecurtus* is almost certainly related to the Tellinacea. In his new investigation he finds that the ciliary mechanisms of the outer gill agree with other members of the Tellinacea (*Gari*, *Scrobicularia*, *Tellina*) and thus a further argument is produced in favour of this relationship. In discussing the homologies of the outer gills of the Tellinacea, the author puts forward various views, the most favourable, which he appears inclined to support, being that the outer gill of *Solecurtus* is not homologous with the outer gill of other lamellibranchs, but is a new structure formed from the supra-axial extension of the outer lamella. There are, however, certain arguments against this view, and the question remains unsettled.

Effect of Moulds upon Tanning Liquors

SEVERAL trees growing in the Philippino Islands yield liquors suitable for tanning purposes. The betel nut, *Areca Catechu*, the black wattle, *Acacia decurrens*, kalumpit, *Terminalia edulis*, and kamachile, *Pithecolobium dulce*, are four of the most important trees. Tanning liquors prepared from them are, however, subject to attack by common mould fungi, and Messrs. Luz Baens and F. M. Yenke have investigated their action (*Philippine J. Sci.*, 61, No. 4, 417-428; Dec. 1936). They found that the activities of the fungi *Penicillium glaucum* and *Aspergillus niger* gradually reduced the tannin content of prepared solutions. A rise in the relative acidity of the liquid was usually accompanied by a large decrease in tannin content. Variations in susceptibility of the liquids to attack by the fungi appeared, for extracts of betel-nut kernel and black wattle bark were susceptible to *A. niger*, but somewhat resistant to *P. glaucum*, whilst kalumpit bark extract allowed *P. glaucum* to increase more than *A. niger*. Both moulds would find their way to the liquid when natural infection took place during practical tanning operations.

Oceanography of Davis Strait

AN important contribution to the oceanography of the north-west Atlantic is contained in the Scientific Results (Part II) of the Marion and General Greene Expeditions to Davis Strait and the Labrador Sea 1928-1931-1933-1934-1935 (Washington: U.S. Treasury Department, 1937. 75 cents). One of the most interesting of many conclusions reached is in

regard to the vertical distribution of water in the Labrador Sea. The intermediate water between 500 and 2,000 metres appears to be derived from the warm, saline West Greenland current. The bottom water is formed by the winter-time chilling of the surface, intermediate and deep water in the northern part of the Labrador basin in the area off-shore from rapid currents. In that area it seems that convection currents occur down to the bottom. On the other hand, in summer the bottom water is isolated from the cold surface water by the intermediate warmer water. Part of the bottom water escapes into the Atlantic basin eastward of long. 38° W., and part may enter round the southern end of Greenland. The report points out the necessity for mid-winter observations in these seas in order to test this theory of vertical movements of water within the Labrador Sea.

Soil Erosion in the United States

A WELL-ILLUSTRATED article by Mrs. E. Huxley on this topic in the *Geographical Magazine* of September reveals some striking facts regarding the devastation of natural resources by over-cultivation, especially in areas of poor soil and steep slopes. It is estimated that more than ten per cent of the total land area of the United States has lost more than three-quarters of its top-soil and that a further thirty per cent can be regarded as moderately eroded. In the Mississippi valley alone, 400,000,000 tons of good rich top-soil are swept annually into the Gulf of Mexico, and in that area twenty-five per cent of the cultivated land has been stripped down to the subsoil and rendered useless for cultivation. A reduced yield of crops is the first sign of soil erosion, and this is generally countered by the use of fertilizers, which are, however, only a temporary remedy. A change in agricultural practice is required, and this is being carried out in some areas. Terracing, strip cropping, embankments along contours and other devices are being used, but most important of all is the reversal from one-crop cultivation to crop rotation and mixed farming. This, of course, will reduce the output of cash crops and mean a greater production of livestock products. The tendency will be to put American agriculture on a basis of home food production rather than intensive export production.

Haboobs in the Sudan

A PAPER read at the Royal Meteorological Society on June 16 entitled "Haboobs and Instability in the Sudan", by J. S. Farquharson, dealt with the cause of disturbances that are distinct from sandstorms and sand-devils, although associated with increases of wind and an atmosphere unpleasantly charged with dust. Recent observations of sand-devils were described in *NATURE* of January 30, p. 201. Sandstorms, according to Bagnold, are clouds of flying sand that rarely extend more than two metres above the ground. The haboob is very much greater in vertical extent than this, contains much smaller particles and in general structure is very different from the slender column of the sand-devil. In this paper a detailed description of all the haboobs observed in 1936 brings out the main characteristics of this phenomenon. A sample of dust in a haboob at Khartoum was collected with the aid of a pilot balloon from a height of 50 feet above the ground and it was found that the greatest length of a particle was generally between 0.01 and 0.07 mm. The observed changes of wind, temperature, etc., seemed

to indicate clearly that the necessary wind is associated with a thunderstorm or at least with a cumulo-nimbus cloud and is of the nature of the outrushing squall of the thunderstorm. The evaporation of rain from such a cloud before it can reach the ground was often observed near Khartoum, this process being very favourable for the development of a high degree of instability, seeing that the descending air in which the rain is evaporating would warm up dynamically at only the saturated adiabatic lapse-rate, while the environment would have a dry adiabatic lapse-rate. The instability resulting in the cumulo-nimbus development appears to occur near the boundary between the south-west monsoon and the north-east trade winds, and this year was more often associated with an advance of the relatively cool air from the north than with a northward extension of the warmer monsoon wind. Photographs of some of the haboobs showed the advancing storm to have a wide lateral extension across the direction of its advance, giving it something of the nature of a line-squall.

Preparation of Germanium and Gallium

THE presence of small quantities of the rare metals germanium and gallium, in coals and flue dusts has been known for some time. Sir Gilbert Morgan and Dr. G. R. Davies (*Chemistry and Industry*, 56, 717; 1937) have recently made a systematic investigation of British coals and flue dusts and find that, with the exception of certain South Wales coals, all contained some germanium, although the ash from Kentish coal contained only a trace. All gas-works' dusts contained both germanium and gallium, irrespective of the coal used, and these flue dusts constitute a valuable potential source of germanium and gallium, so that by suitable and probably minor alterations in working conditions, a material could be obtained which would be much richer in these metals than anything hitherto examined. It was found that loss of germanium occurs when a coal is burnt, so that its presence in flue dusts is explained. The method used for the extraction of the germanium and gallium was the distillation of the volatile germanium tetrachloride by heating the material with hydrochloric acid in a still, and the extraction of gallium trichloride from the residue by means of ether. The authors calculate that very large quantities of germanium and gallium are annually dissipated into the atmosphere or discarded as useless dust by the combustion of coal. F. Sebba and W. Pugh (*J. Chem. Soc.*, 1371, 1373; 1937) also describe an improved method for the extraction of gallium and germanium from the mineral germanite. The usual method of acid extraction leads to a troublesome separation from copper, iron, lead and zinc, and the extraction of gallium is probably incomplete. The new method consists in digesting the finely powdered mineral with sodium hydroxide solution. In this way both the rare elements are concentrated in a single operation. The authors also describe the electro-deposition and purification of gallium. Conditions for the electro-deposition of quantities of the order of 10 gm. of the metal are specified.

Carbon-Carbon Bond Distances

L. Pauling and L. O. Brockway, in considering the dependence of interatomic distances on resonance, have assumed that the C-C single bond is characterized by the distance 1.54 Å., as in diamond, and

the shorter distances observed in several compounds have been attributed to partial double bond character resulting from resonance. It might, however, be questioned whether this interpretation is justified, as the single bond radius for aromatic carbon might well be different from that for aliphatic carbon. These authors have now (*J. Amer. Chem. Soc.*, 59, 1223; 1937) determined the configuration of thirteen hydrocarbons by the electron diffraction method and have arrived at the conclusion that the value assumed for the carbon double bond covalent radius, obtained by linear interpolation between the single bond and triple bond radii, is 0.02 Å. too large. They now give corrected values for covalent radii as follows:

Bond	C	N	O	F	Si	P	S	Cl
Single	0.77	0.70	0.66	0.64	1.17	1.10	1.04	0.99
Double	0.67	0.61	0.57	0.55	1.06	1.00	0.95	0.90
Triple	0.60	0.55	0.51	—	0.99	0.93	0.88	—

In the case of other atoms than the first four, it is supposed that the factors converting single to double and triple bond distances are somewhat different from 0.87 and 0.78 adopted in the above table. The curve drawn by the authors connecting interatomic distances and bond types is somewhat altered. It does not differ appreciably from the old one up to 50 per cent double bond character; in the region between 50 per cent and 100 per cent double bond character the new curve makes it possible to determine bond type, whilst the old one was useless because of its small slope. They also show that the curve may be represented by an equation based on a potential function for a resonating bond as given by the sum of two parabolas, representing single bond and double bond potential functions.

Bright Solar Eruptions and Radio Fadings in 1935-36

Messrs. H. W. Newton and H. J. Barton have produced a very comprehensive paper (*Mon. Not. Roy. Astro. Soc.*, 97, 8, June 1937) in which a comparison is made between sudden radio fadings and bright eruptions observed on the sun in hydrogen light or in that of ionized calcium. In 1936, when rapidly increasing solar activity took place, 29 close associations of radio fadings with bright solar eruptions were recorded, and in those cases where the origin of the solar eruptions was observed, the radio fadings took place 7 minutes before the observed time of the solar eruption. There is no doubt that the fadings are due to a solar agency, travelling with the approximate speed of light from a limited part of the sun's chromosphere. The data are insufficient at present to show any correlation between terrestrial magnetic effects and radio fadings, and, in addition, are insufficient to establish a tendency for fadings to recur in intervals of 27 or 54 days.

The Orbit of OΣ 79

MR. L. T. S. SYMS has published a paper with this title (*Mon. Not. Roy. Astro. Soc.*, 97, 8, June 1937). The preliminary orbit was computed by Russell's method, largely a graphical one, and then the method of Innes and van den Bos was applied for a more definitive orbit. The period of this binary is 89.20 years, the semi-axis major 0.53", and the inclination $\pm 51.6^\circ$. It is interesting to notice that the elements give a dynamical parallax of 0.021", as compared with the spectroscopic parallax 0.022" determined at Mt. Wilson and the trigonometrical parallax 0.046" \pm 0.06" found at Allegheny.

Universities and Education

THE discussion in Section G (Engineering) of the British Association at Nottingham on September 3 on the training of university graduates for the engineering industry, which was opened by Prof. F. G. Baily, was notable not only for the high level sustained, apart from one or two lapses, but also for some stimulating remarks on the functions and character of university training in general which merit the attention of a wider audience.

In his introductory paper, Prof. Baily reviewed the scope and subject-matter of the various courses at present followed, and urged that for most men the practical training should follow the college course. He does not consider that the theory of commerce or industry should be included in the three-year curriculum, but should preferably be studied after some practical experience has been acquired. It is also doubtful whether a fourth year of study repays all students for the time spent. Prolonged study of theory may be of slight benefit to students of medium capacity and of little use in several branches of employment. Prof. Baily also stressed the value of the sandwich system and the perspective which some manual training gives as well as the closer contact with the workmen. The latter, rather than the acquisition of manual skill, are the most valuable results of manual training.

Dr. W. Jackson, who presented a joint paper with Dr. A. P. M. Fleming, stressed the need for a more effective co-ordination of the resources of the universities and of industry. The task of educating and training for engineering careers those who will ultimately occupy positions of high technical and administrative responsibility is a joint responsibility between the universities and industry, and Dr. Fleming and Dr. Jackson pleaded for a broader interpretation of industry's share in this responsibility. They made the somewhat revolutionary suggestion that the large industrial organizations should accept the responsibility of training such men for the country as a whole, and that the smaller concerns should no longer recruit direct from the universities. The tendency to include industrial administration and an increasing amount of specialized technological information in university courses was again adversely criticized, Dr. Jackson pointing out that this overloading or undue specialization is detrimental to their educational value. Opportunities for independent reading and thinking, and the exercise of originality, may be unduly restricted, and too high a premium placed on memory and the ability to reproduce information in the exact form in which it has been communicated in the lecture. The undergraduate stage is much too early a stage at which to encourage intensive specialization.

Dr. Fleming and Dr. Jackson suggested that the universities might now reasonably expect the large industrial firms to undertake, both independently and in co-operation with adjacent technical colleges, the necessary systematic instruction in the specialized branches of engineering technology with which they are concerned. If facilities for combined practical and technological training could be made available on a wide scale, the opportunity for a liberal education at the university and the effectiveness of the overall training could be increased considerably. Moreover, if released from technological obligations, the universities could

do much to stimulate in the embryo engineer the development of broader interests and participation in wider fields of activity. If engineers are to make their full contribution to the solution of the complex problems of modern life, their interests cannot be limited to technical matters, and the opportunities for humane studies and for participation in the corporate life of the university are two of the most important attributes of a university education.

Finally, Dr. Fleming and his colleague, referring to the universities and industrial research, urged that men of outstanding ability should be given the opportunity to return for one or two years to an appropriate university, either at home or abroad, to learn more effectively the method and art of research and to enhance their fundamental scientific knowledge. A regular stream of such men from industry, endowed by adequate joint scholarship provision, would exercise a very stimulating effect on the research and teaching activities of the universities. In addition, the engineering departments of the universities have an excellent opportunity for co-operative research with the physics, chemistry and metallurgical departments on borderline subjects in which industry is keenly interested but which an industrial research laboratory may be unable to tackle. Industry should also afford facilities in its research laboratories for members of university staffs to carry out or supervise supplementary work beyond the scope of their financial resources, thus assisting them to keep in touch with outstanding industrial problems.

Many of the points made in these two papers were strongly endorsed in the discussion which followed. In a written communication describing the training of engineer recruits for the Post Office service, Sir George Lee referred to the stress laid on personality, judgment and character in candidates rather than on technical knowledge, and emphasized the importance of a wider cultural education with, if possible, two foreign languages. A general education which equips the engineer to take some part in everyday affairs is much to be preferred to the present over-specialized education.

Mr. S. V. Goodall, who dealt with the Admiralty system of recruitment and training for the Royal Corps of Naval Constructors, referred particularly to the Admiralty's efforts to obtain university graduates who have not had any experience in shipyard work but have attained a high standard in mathematics and naval construction.

Sir T. Hudson Beare, after emphasizing the value of instruction in design as affording a means for expressing creative ability, asserted that the fundamental task of the university is to turn out trained minds able to absorb knowledge readily later on in life when left to their own resources, and to take their proper place in the life of the nation. The only specialization at a university should be specialization in the fundamental principles of the science. Mr. H. A. Ward, of Messrs. Rolls-Royce, Ltd., described a recent experiment in the employment of university graduates which is giving promising results, and Prof. C. H. Bulleid endorsed a number of Prof. Baily's and Sir Hudson Beare's remarks regarding premature specialization and the place of university training. Prof. E. W. Marchant also strongly endorsed the value of a university training for an engineer,

stressing particularly the importance of association with other students, and paid tribute to the work done by Dr. Fleming to encourage the employment of university graduates in industry.

Other speakers in the discussion reiterated the importance of concentration upon fundamental principles and humanitarian studies in a university training, while in regard to research it was pointed out that the greater expensiveness of engineering research, as compared with research in the physical sciences, is often a great handicap to the universities in initiating such work. Prof. R. V. Southwell suggested that the time is ripe for a drastic revision of engineering curricula, and a further speaker urged an inquiry into the whole question of scientific education, with the view, among other things, of eliminating the overlapping which at present exists between the technical schools and colleges and the universities.

The educational functions of the university were also touched upon from a different aspect in discussions before Section L (Educational Science). Incidental reference was made to the part of the university in the discussion on education for the community on September 3, although Prof. A. M. Carr-Saunders did not present his paper on this subject. A special session on September 6 was, however, devoted to the educational function of the university. Sir Richard Livingstone, who opened the discussion, took as his main theme the need for a new type of adult education which the universities are pre-eminently qualified to impart.

If the university sends out graduates with a thorough mental training and a background, it has done what it can to prepare them for life. When, however, education ceases at the age of twenty-two or twenty-three years, in our swiftly changing world a man is very liable to lose intellectual energy by the time he is forty and fail to keep up with advancing knowledge. Sir Richard urged that everyone engaged in routine or practical work, especially if he occupies a directing or controlling position, needs periods of systematic study to refresh, re-equip and re-orientate his mind. There is no occupation or profession in which the resumption of systematic education in later life would not be profitable, and there are few who would not greatly profit by it. Already in medicine and in teaching, refresher or vacation courses are being arranged, and Sir Richard referred to experiments in the same direction in civil and local government service. The Commonwealth Fund awards three fellowships for study in the United States to civil servants to enable them to carry out inquiry or research on problems akin to those which come within the scope of the Department in which they are serving. A summer school in colonial administration has been organized by the University of Oxford with the encouragement and help of the Colonial Office and Colonial Governments, in which detailed problems of native administration are placed in a wide general and comparative setting. A third instance is the growing practice of granting officers leave for part-time study in such courses as the diploma course in public administration at Oxford.

This type of adult education, which enables the student to place his special subject against the background of modern civilization, can only be supplied by the universities, and an extension of the practice of seconding promising officials for systematic study at the university would do much to break down the dangers which routine continually threatens. Moreover, this practice would tend to remedy the serious

neglect of the social sciences. Bringing back to the university in this way the civil or municipal servant, the medical or other professional man and the business man, with the first-hand knowledge of social conditions which they possess, would not only add to the data on which the social sciences depend and stimulate the cross-fertilization of theory and practice which is such a fruitful source of advance, but also assist to prevent disastrous mistakes in the study of these sciences, which aim at directing the policy of Governments and the conduct of millions of human beings.

The functions of the universities in regard to the social sciences were discussed in still greater detail by Prof. M. Ginsberg, who condemned the divorce of the teaching of the social sciences from that of social philosophy. This separation is the more unfortunate because the problems of deepest interest to layman and student alike are those in which questions of value and questions of fact are closely interwoven, and to see them in their proper relation is of the most vital importance. The training at present provided in the universities is not well calculated to achieve this object, for students, while trained in marshalling and correlating facts, have no parallel experience in weighing values or in disentangling values in complex social situations. Social science has two functions to fulfil, both of special relevance and urgency at the present time. The first, or critical function, is concerned with the pre-suppositions or assumptions underlying common-sense and scientific thought about social phenomena and with the nature and validity of the methods employed in investigating them. It is urgently necessary that philosophy should attempt to provide a critical apparatus for scrutinizing and evaluating the methods and assumptions made by the social sciences, and particularly the fundamental conceptions from which a synthesis of the social sciences may proceed. A philosophical analysis of the conceptions of social change, which are in fact employed, for example, in the different social sciences, would greatly help in clarifying the present confusion. Similarly, the philosopher could do much to guard against confusions which may arise out of misunderstandings regarding the logical character of the laws and the relations between necessity, freedom and law. The relation between purely deductive studies and the more concrete or inductive handling of economic data also requires elucidation.

That function of social philosophy which is concerned with the problem of values is, however, of even greater importance to-day and Prof. Ginsberg considers that in economic questions the moral issues involved at present most urgently require clarification. In many cases our moral judgments of particular institutions would be transformed if we had fuller knowledge of the ends actually attained in relation to the ends they are intended to serve. The effective handling of social problems involves a synthesis, but not a fusion of social science and social philosophy, and co-operation is even more important in the teaching of political science and especially of international relations. The present neglect of philosophy is due partly to the little attention devoted to social problems by philosophers, and particularly to the failure to bring the teaching of ethics into relation with present needs. Prof. Ginsberg considers that great changes are required in the teaching of both social science and social philosophy if the universities are to make their rightful contribution towards the rational ordering of society.

National Smoke Abatement Society

ANNUAL CONFERENCE AT LEEDS

THE ninth Annual Conference of the National Smoke Abatement Society was held in the Philosophical Hall, Leeds, on October 1-2. The morning session on October 1 began with the annual meeting of the Society, during which Dr. H. A. Des Vœux delivered his presidential address, which was entitled "Idealism".

After reference to the high ideals of cleanliness, both personal and civic, possessed by the ancients, and to the lack of hygiene in the Middle Ages, Dr. Des Vœux passed on to consider present-day standards. He asked whether we can pretend to-day to have recovered the ancient Greek ideal of clean and open cities. We still tolerate slums in our midst; we are yet content to live in cities periodically blotted out by fog and permanently wasted by sulphur-bearing fumes. Were every citizen an idealist, the City Fathers would have the authority and could exercise the power to clean the atmosphere.

Prof. R. W. Whytlaw-Gray (University of Leeds) presided over the discussion on town planning and smoke abatement which followed, and referred to results of recent research on the nature of atmospheric pollution. All smokes are in the process of natural coagulation, and the form of the deposit from polluted air depends on the degree of coagulation. Measurement of the size-range distribution of the particles probably affords the best means of assessing the injurious nature of polluted air, and it seems that fine particles, for example, of radius less than 0.5μ , are mainly responsible for the harmful effects. Such particles ($0.3-0.1\mu$) often form 50 per cent by weight of the solid matter in Leeds air.

Papers on town planning and smoke abatement were then read by Mr. J. E. Acfield (city engineer and surveyor, Leeds) and Mr. C. Gandy, of Manchester (chairman of the Executive Committee of the Society). Mr. Acfield discussed the doubts which exist regarding the possibility of creating smokeless zones under existing planning powers. The sections of the Act relating to 'zoning' appear to mean that enforcement of restrictions on present users regarding the fuel to be used would involve payment of compensation, and asked what possibility there is of action being taken under these conditions. Speaking of the present position in Leeds, he said that in the case of 27 buildings of any magnitude erected in the central area since April 1, 1930, the type of fuel used for central heating is in 18 cases coke, 3 coal, 5 oil and 1 gas; and in all cases where the fuel for cooking is known it is gas, electricity or steam. If the Corporation had possessed powers to require the change, subject to compensation, it would probably have achieved little more and might have been at considerable cost to do so. In a light industrial zone adjoining a large rehousing area, however, the Corporation has insisted on smokeless methods of generating power. There are now 4,200 municipal houses equipped with coke-burning ranges, yet despite an adequate supply the quantity of coke used by the tenants is deplorably small (85 tons for the 12 months ending in June 1937).

Mr. Gandy said that the time has come to consider the smoke problem as an integral part of the task of the town planner. Present restrictions on smoke emission are practically confined to factory smoke; attention should now be directed to the control of non-industrial smoke. He put forward a strong plea that legislation should be established empowering local authorities to make by-laws or schemes under which the omission of smoke would be declared a statutory offence in certain areas selected for that purpose. He gave reasons why the central areas in many cities would probably prove most suitable for selection in the first instance.

The two papers provoked a lively discussion, in which the need for appointing specially qualified whole-time smoke inspectors was emphasized. Duties in this respect usually fall to the already overworked sanitary inspector. Whilst an educational campaign for the general public is obviously required, it is imperative that the local administrators should be the first to be made 'smoke-conscious'.

In the afternoon session, devoted to the discussion of the reports from the regional committees of the Society, opinions were divided regarding the necessity for further legislation to advance the cause of smoke abatement, but it was suggested more than once that the fullest use is not being made of existing powers.

On October 2, Mr. Arnold Marsh, general secretary of the Society, presented a report on behalf of the Executive Committee on "Education and Smoke Abatement". Prof. J. W. Cobb (University of Leeds) who presided, referred to the prime necessity of arousing the public conscience to the harm done by smoke. For this it is necessary to look to education all the time, to education of different grades, all seeking the same end: the efficient utilization of fuel for the generation of heat, light and power with the minimum of atmospheric pollution.

Mr. Marsh stressed that information on the value of a pure atmosphere should be given in schools. It need not form an additional subject, but appropriate aspects of it should be incorporated into the normal course of such subjects as hygiene, domestic economy and general or elementary science. He outlined the contents of booklets which might be distributed to teachers to provide the necessary information.

In the ensuing discussion, Dr. F. A. Mason, representing the Board of Education, said that the children must be made conscious that the veil of fog and murk which prevents their enjoying the welcome warmth and health-giving rays of the sun is not an act of Nature but of man's own handiwork. The Board of Education is quite prepared to favour the introduction of some instruction on the smoke evil.

The views of a science school-teacher were expressed by Mr. Pixton, who said that smoke abatement is an excellent subject for the school curriculum and offers scope for interesting and informative experiments. He urged that in pressing for the introduction of the subject into school courses, the co-operation of the teachers' unions should be secured.

A. L. ROBERTS.

Larvæ of Decapod Crustacea*

THE first contribution to the study of the decapod larvæ of the "Discovery" expedition deals with the Stenopidea, Amphionidea and Phyllosoma. The whole collection is so large that the easiest and best way to treat it is by taking the groups separately irrespective of systematic order. The three sections chosen are of peculiar interest, and their elucidation has entailed an enormous amount of labour, eminently worth while.

Most of the plankton samples were taken far out to sea, and one of the features of the collection is the abundance of late larvæ, whilst early larvæ are comparatively scarce. For this reason, it is rarely possible to complete a life-history of any form. In Part 1, Stenopidea, the author was fortunate in obtaining larvæ hatched from the egg of *Stenopus hispidus* from Bermuda (previously somewhat inadequately described by Brooks and Herrick), which has enabled him to recognize later larvæ and to establish certain generic characters. Two further species (presumably) of *Stenopus* are described and six more belonging to the Stenopidea, and a key is given to the stenopid larvæ described.

Part 2, on the Amphionidea, is of special interest, for *Amphion* is a form which has led to much controversy both as to its systematic position and as to whether it is a larval or adult animal. There can be now no doubt that the oldest specimens known are immature, and Dr. Gurney is almost certainly right in referring *Amphion* to the Caridea (as Korschelt and Heider had previously suggested). Given that it is a carid, then he believes that the only known

genus to which it can be referred is *Amphionidea*, three specimens of which were found in the "Discovery" material, from a depth of 2,500-2,700 metres. This most extraordinary decapod is so tender that in all instances known it is much damaged; but a construction of one of them certainly shows a distinct likeness to *Amphion*. Zimmer, who first described *Amphionidea*, regarded it as a larva and observed that it closely resembles *Amphion*. Dr. Gurney remarks that he might have gone further and claimed it as an adolescent post-larval stage in the development of that crustacean, for, as he shows, *Amphionidea* is certainly a post-larval form. All this is most interesting and suggestive.

Part 3 deals with the Phyllosomas, and here the work is remarkable, for no fewer than four hundred specimens have been examined and measured, and about a dozen forms recognized. No series, unfortunately, is complete, and no very early stages are present. Nevertheless, generic larval characters are described which distinguish *Palinurus*, *Panulirus*, *Jasus*, *Scyllarus* and *Scyllarides* and, probably, *Palinurellus*, *Thenus* and *Parribacus*. A very large amount of information is given in connexion with these Phyllosomas which will help enormously in future work.

This first section of the expedition's decapod larvæ promises well for future parts.

* Discovery Reports, vol. 12, pp. 377-440. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Larvæ of Decapod Crustacea. (1) Stenopidea. (2) Amphionidea. (3) Phyllosoma. By Dr. Robert Gurney. (Cambridge: At the University Press, 1936.)

Forestry in Great Britain

THE progress of the afforestation work being carried out by the Forestry Commission in Great Britain for the year ending September 30, 1935, is detailed in the sixteenth annual report (London: H.M. Stationery Office, 1936). During the year, the programme of work was that laid down by Government at the time of the financial crisis of 1931. In January 1935, the Commissioners reported to Government that it was desirable to review the position generally and to extend the current five-year programme, so that the work might be organized to the best advantage.

The Commissioners consider that a steady development is preferable to a sudden large increase of work which might lead to waste. They suggested therefore: (1) that the acquisition of land and the supply of plants should be speeded up; (2) to work up to an annual planting programme from 21,000 acres to 30,000 acres over the next four years; (3) to continue expanding the programme up to 45,000 acres per annum. Of interest are the remarks made upon Jubilee forests, unemployment training camps, national forest parks and home timber trade.

With the permission of the late King George V,

three forests have received Royal designations to commemorate the jubilee, namely, the King's Forest in Suffolk, the Coed-y-Brenin (the King's Forest) in Wales, and the Queen's Forest in the Cairngorms.

In co-operation with the Ministry of Labour, sites of training camps and work such as road-making, etc. have been provided. During the year there were in all thirteen permanent camps and fifteen summer camps, with accommodation for 5,000 men. The camps were distributed at different centres throughout Great Britain.

The question of the formation of national parks has been under consideration by various bodies and individuals for some years past. The Commissioners appointed a committee, under the chairmanship of Sir John Stirling-Maxwell, to consider a specific example. The Commissioners have already, as a result of their land purchases, a considerable area of unplantable land. The Committee took a Scottish example consisting of unplantable land in the Forests of Ardgartan, Glenfinart, Benmore and Glenbranter in the County of Argyll. This area, including the adjacent Ardgool Estate belonging to the Glasgow Corporation which the Corporation is willing to

bring into the scheme, extends to 100 square miles and has now been earmarked as a national park to be used for campers, the youth movement body, and so forth. Funds have been obtained to provide camping sites, alpine huts and for the acquisition of Ardgartan House and policies.

A record is being prepared of the exceptional May frosts of the year 1935, which did a serious amount of damage in different parts of the country. The chief frosts occurred between May 13 and 19. The record of the susceptibility of the numerous species, conifer and broad-leaved, given in the report corresponds with previous statistics in this matter.

During 1935, the question arose as to whether afforestation could be of use in assisting the Special Areas. As a result of investigations, it has been found that a certain amount of land could be purchased for forestry purposes within fifteen miles of certain Special Areas, and that, as a preliminary, 1,000 forest workers holdings could be established and a certain amount of work provided. Grants have been made by Government both to speed up the afforestation programme and to assist the schemes in connexion with the Special Areas.

The information on the 1934 seed crops is of interest. During that year, the Sitka spruce crop was only moderate in Canada and the United States, and therefore the Commissioners (and others) were unable to obtain their full requirements. Douglas fir was good and Japanese larch seed abundant in Japan. In Europe, Norway spruce, European larch and Corsican pine were not too plentiful. Oak seed was in fair quantities, but beech was scarce. Of home-collected seed, the supplies of the chief forest species were sufficient to abundant.

Of the net total area of land acquired by lease, feu and purchase in Great Britain to September 30, 498,146 acres were classified at the time of acquisition as plantable, and of this area 301,133 acres (60 per cent) were in England and Wales and 197,013 acres (40 per cent) in Scotland. In addition to the above-mentioned areas, Crown woodlands extending to about 120,000 acres (of which some 60,000 acres are plantable) have been transferred to the Forestry Commissioners. The total area of land in the Commissioners' control thus approximated to 929,000 acres.

The Commissioners' seventeenth report for the year ending September 30, 1936 (London: H.M. Stationery Office, 1937) recently issued, shows the progress made. The Argyll National Park was inaugurated and a camping ground, car park and buildings for the use of campers were formally opened at Ardgartan. The question of instituting a similar park in Wales is now under consideration. The Special Area afforestation scheme received the sanction of Government and the Commissioners were authorized, as a first instalment covering the years and largely as an experiment, to acquire and begin to plant 100,000 acres and to establish 500 holdings. These plans were made public in February 1936. In the remaining months of the year under report were concerned with the preparatory work—acquisition of land and staff and provision of the necessary trees for planting purposes. Steps were being taken to cultivate a larger area of nursery ground. By May 1937, says the report, some progress had been made.

Owing to the wet year there were fewer fires. The total area of land under the Commission amounted to 954,500 acres and the area planted to 296,452 acres.

Science News a Century Ago

The Franklin Institute

THE fifty-fifth quarterly meeting of the Franklin Institute, Philadelphia, was held on October 19, 1837, when the usual quarterly report of the managers was read. Although the period covered by the report had not been marked by any new undertakings, the several sub-divisions of scientific and practical subjects had been encouraged with all the means at the disposal of the Society.

The interesting investigations on the cause of explosions of steam boilers had been concluded and the Government and the community had been put in possession of the results of the experiments and of ample directions tending to prevent the occurrence of accidents. The final report of the committee on the value of water as a moving power was expected to be ready shortly. The experiments made under the authority of the Institute were of the most perfectly practical character, and the application of a sound theory, deduced from practical results, would be put at the command of those interested.

The committees on science and the arts had sedulously prosecuted inquiries desired by inventors and others; the department of instruction had arranged for regular courses in chemistry, natural philosophy and mechanics. In addition to the usual augmentation to the library, "about one hundred volumes have been received from our esteemed member, Professor Bache, President of the Girard College, now in Europe. These books have been purchased out of a fund placed in the hands of Dr. Bache by the subscriptions of the members, and have been selected by a mind distinguished by its discrimination and devoted to practical science. . . ."

Launch of S.S. *Liverpool*

ON October 18, 1837, the wooden paddle-wheel steamship *Liverpool* was launched in the Mersey. The largest vessel built at Liverpool up to that time, she was constructed for Sir John Tobin, but became the property of the Transatlantic Steam Ship Company. She was built by Humble and Milerest, and was 235 ft. long, 35 ft. beam and about 1,150 tons. Her engine, made by Forrester and Co. at the Vauxhall Foundry, had two cylinders, 75 in. diameter and 7 ft. stroke, and was of 468 horse-power. She is said to have cost £45,000. The *Liverpool* was the fourth of the steam vessels by which, in 1838, regular steam communication was maintained with America. The *Sirius* and *Great Western* made their first passages in April 1838, and the *Royal William* first crossed in July 1838. The *Liverpool* sailed from Liverpool on October 22, 1838, had to put into Queenstown, and finally reached New York on November 23. Her return voyage began on December 6 and ended on December 21.

Civilization and Insanity

THE *Gazette medicale de Paris* of October 21, 1837, contains the following information: At a meeting of the Academy of Sciences on October 10, M. Brière de Boismont dealt with the different countries in which he had been able to obtain information as to the figures of insanity. "What we have shown," he said, "gives us the right to regard insanity as a product of civilization. We have seen it reach its greatest development in the most enlightened nations, diminish as we penetrate into despotic governments

or into recently emancipated countries and disappear almost entirely when our researches have taken in any savage people." M. Brière de Boismont then submitted tables showing the number of the insane in the principal European capitals with the population of each capital and the population of the different European countries and New York State, with the number of insane interned in each country.

Encouragement of Vaccination

AN editorial in the *Lancet* of October 21, 1937, contains the following information and suggestion: "At the last meeting of the Royal Academy of Medicine, Paris, there were distributed by order of the French Government for the encouragement of vaccination rewards of £60 to three medical men who had shown themselves most active in the propagation of that inestimable benefit during the course of the preceding year. Four gentlemen received handsome gold medals; and no less than a hundred persons were rewarded with silver medals. It would be highly desirable that our own Government should adopt some similar method of encouragement. Numerous accounts from correspondents inform us that small-pox prevails to a very great extent in some of the poorer districts, where we are sorry to say, vaccination seems to have been neglected in a deplorable manner".

University Events

BIRMINGHAM.—At its last meeting the Council of the University was informed that the vice-chancellor and principal (Sir Charles Grant Robertson) had placed his resignation in the hands of the pro-chancellor (Mr. Walter Barrow), so that in accordance with the statutes of the University it may be considered at a meeting of the Court of Governors, which will have before it also the nomination of Dr. Raymond Priestley, of Melbourne, as his successor.

OXFORD.—At Merton College Dr. G. M. B. Dobson has been elected to an official fellowship and Prof. R. Campbell Thompson, formerly research fellow, to a professorial fellowship.

At Balliol College Dr. Simon Flexner (George Eastman visiting professor) and Dr. J. A. Gunn (on appointment as director of the Nuffield Institute of Medical Research) have been elected to supernumerary fellowships. Dr. J. H. Burn has been elected to a professorial fellowship and J. St. L. Philpot, formerly tutorial fellow, to a senior research fellowship.

Dr. A. A. Bake, of the University of Utrecht, has been appointed to a senior research fellowship at Brasenose College for research on the religious songs and music of India. Dr. Bake is working under the guidance of Sir Rabindranath Tagore. He has already been engaged in research in India on the Sanskrit theory of music and the folk-music of India in 1925-26 and 1930-34.

READING.—Sir Samuel Hoare has been elected Chancellor of the University and will be installed on November 29.

ST. ANDREWS.—At a graduation ceremony on October 8 the honorary degree of LL.D. was conferred upon Dr. W. T. Calman, former president of the Linnean Society, and lately keeper of the Zoology Department of the British Museum (Natural History).

Societies and Academies

Paris

Academy of Sciences, August 9 (*C.R.*, 205, 345-380).

LOUIS DE BROGLIE: The quantification of the field in the theory of the photon.

PIERRE LEJAY: The general characters of the acceleration of gravity in the Levant. A map of the countries of the Levant under French mandate is given, showing the anomalies in the value of g .

CHARLES EDGAR WINN: Some reducibilities in the theory of charts.

LUBOMIR TCHAKALOFF: A problem of Laguerre and its generalizations.

RAYMOND JACQUESSON: The variations of the internal friction of solids under the influence of thermal and mechanical treatments. The influence of a traction.

SANTIAGO ANTUNEZ DE MAYOLO: The charge e of the electron and the materialization of the photon.

MME. IRÈNE MIHUL and CONSTANTIN MIHUL: The ionization of the lower part of the ionosphere. A theory is proposed based on the ionizing action of the sun varying with the latitude: this is regarded as explaining all the known facts.

JULES FARINEAU: The spectrographic study of the conductivity electrons in the alloys of magnesium and aluminium.

JEAN BERNAMONT and MICHEL MAGAT: A new method for separating isotopes.

ANDRÉ DEBIERNE and LADISLAS GOLDSTEIN: The new transformations produced at low temperatures (*frigadreactions*). Correction of an error of printing in note of August 2.

ALFRED REIS: The measurement of the angular domain of reflection of the X-rays in polycrystalline substances by a new statistical method.

JACQUES GILBERT: The indirect experimental verification of the logarithmic increase of wind velocity starting from the ground. The method is based on the quantity of hoar frost deposited on a vertical rod exposed to the wind.

MARCEL AVEL: Experiments on the role of the complex digestive tube plus non-cutaneous mesodermic tissues, in the regeneration of the head in worms.

LOUIS GALLIEN: The masculinizing action of testosterone propionate in the differentiation of sex in *Rana temporaria*.

ALBERT PEYRON, BERNARD LAFAY and GUY POUMEAUX-DELILLE: The regression of the papillo-epithelioma of the rabbit (Shope's tumour) under the action of colchicine.

August 18 (*C.R.*, 205, 381-396).

MARTIN FERBER: The structure of the order of statistical series of the exponential type.

AUGUSTE GOSSEPIERES: Study of the hydrolysis of solutions of cobalt chloride.

V. M. MITCHOVITCH and G. STEFANOVITCH: The reduction of glycerides by the Bouveault and Blanc method.

ROGER GUY WERNER: Cryptogamy and phytogeography.

EMILE F. TERROINE and MME. SIMONE SYNEPHIAS: The relative participation of the proteins and lipids in meeting the energy losses in starvation.

MLEK. DIGNA VAN STOLK and ROLAND LEROY: Folliculin and dihydrofolliculin in the urine of pregnant mares.

Rome

National Academy of the Lincei (*Atti*, 25, 75-100; 1937).

G. SANSONE: Cesaro's summability of the Laplace series.

B. FINZI: Propagation of movement in threads.

G. PICCARDI: Molecular spectra and spectroscopic analysis (6). Detection of samarium.

A. C. BLANC: *Hippopotamus* fauna and palaeolithic industries in the deposits of the littoral grottos of Monte Circeo. Grotto delle Capre (1). Grotto del Fossellone (2).

L. CALIFANO: Investigations on the glycolysis of the retina.

Atti, 25, 101-144; 1937.

G. ROVERETO: New tectonic synthesis of the western Alps.

R. CALAPSO: Systems of lines of a surface which are invariant with respect to a transformation for a W congruence.

I. POPA: Asymptotic transformations of oblique curves.

G. SESTINI: Translo-circulatory current in presence of an arc of circumference with an eccentric source.

O. ZANABONI: General proof of the principle of De Saint-Venant.

L. LABOCETTA: Potential energy and curvature in gravitational fields.

A. IANDELLI and E. BOTTI: Crystal structure of the compounds of the rare earths with the metalloids of the fifth group. Nitrides of lanthanum, cerium and praseodymium (2).

B. L. VANZETTI and P. DREYFUSS: Configuration of oliv and of iso-oliv.

F. CEDRANGOLO: Amilase activity of the adipose tissue.

A. CAVINATO: Valentinite from the Ballao mine.

Sydney

Royal Society of New South Wales, August 4.

T. G. ROOM: The virtual genus of a curve with a multiple point.

S. J. HAZLEWOOD, G. K. HUGHES, F. LIONS and others: Pyrroles derived from acetylacetone. The Paal-Knorr synthesis of pyrroles from amines and 1:4-diketones has been studied for acetylacetone, and 37 new N-substituted 2:5-dimethyl pyrroles described. Pyrroles could not be obtained from *o*-nitraniline, tribromaniline, methyl anthranilate or *o*-aminobenzamide. On the other hand, anthranilic acid reacts readily to form N-*o*-carboxyphenyl-2:5-dimethyl pyrrole. Methyl anthranilate also fails to form pyrroles with ethyl phenylacetoacetate and with phenacyllaevulinic acid.

G. K. HUGHES and F. LIONS: Derivatives of higher catechol ethers. Attempts to sulphonate catechol di-*n*-butyl ether led to dealkylation. Hence, some reactions of catechol di-*n*-butyl ether and catechol di-*n*-amyl ether have been studied in comparison with veratrole. The higher ethers and derivatives appear to behave normally except in presence of sulphuric acid or chlorosulphonic acid.

K. J. BALDICK and F. LIONS: Derivatives of 6:7-dimethoxybenzoparathiazine. Treatment of 1-sulphydryl-3:4-dimethoxybenzene in alkaline solution with chloracetic acid gives 3:4-dimethoxyphenylthioglycolic acid, which nitrates in cold glacial acetic acid to 2-nitro-4:5-dimethoxyphenylthioglycolic acid (I), but in the hot is converted into 2-nitro-4:5-dimethoxyphenylsulphoxide acetic acid (II). Both I and II can be oxidized to 2-nitro-4:5-dimethoxyphenylsulphone acetic acid (III). Reduction with tin and hydrochloric acid of I gives 3-ketodihydro-6:7-dimethoxybenzoparathiazine and of II gives 3-ketodihydro-6:7-dimethoxybenzoparasulphazone.

Tokyo

Imperial Academy (*Proc.*, 8, No. 7, July 1937).

GEMMYO ONO: Subhakara-simha's Rta-saṅgraha. "Compendium of Truth" introduced into China by the Indian priest Subhakara-simha (716-735).

TADAO DOI: Researches in the Japanese language made by the Jesuit missionaries in the sixteenth and seventeenth centuries. Grammatical and lexicographical works showing the development of the language.

AKITSUGU KAWAGUCHI: Theory of connexions in a Kawaguchi space of higher order.

UNAI MINAMI: An extension of the Phragmén-Lindelöf's theorem.

SEITI IRIE: A theorem of Beurling.

JUICHI OBATA and RYUJI KOBAYASHI: A direct-reading pitch recorder and its applications to music and speech. Apart from recording simultaneously the intensity of sound and pitch variation in music and speech, it is suggested that the apparatus described can be used for industrial purposes, such as determining the number of revolutions of a rotating machine.

HANTARO NAGAOKA and TSUNETO IKEBE: Magnetic variation during an explosion of Asamayama, and its mechanism. During the eruption of the volcano, magnetic disturbance, mechanism of explosion, tilts and role of water were studied.

NAOMI MIYABE: Results of re-levelling in Kyūsyū, Japan. During re-levelling, details of the chronic deformation which is taking place were examined.

TSUNEYUKI KIMURA: An improvement on cyanin synthesis (mixed solvent process) and the reaction of orthothioformic ester. Several new trinucleo carbocyanins were synthesized by the mutual actions of orthothioformic ester with cycloammonium quaternary salts.

FUMIO HIRATA: Rigidity and constitution of a thermo-reversible gel.

YASUO TAZAWA: Splitting of glycyl glutamine acid anhydride by means of crystalline trypsin.

ICHIRO IITAKA: A new equilibrium diagram for the system Fe-C (see NATURE, 140, 462; 1937).

SANSHI IMAI: An edible Mongolian fungus, 'pai-mo-ku'. This proved to be a new species of the genus *Tricholoma*, and the name *T. mongolicum* Imai, sp. nov. is proposed.

YO K. OKADA and YOSHIKI MIKAMI: Inductive effect of tissues other than retina on the presumptive lens epithelium.

Forthcoming Events

Monday, October 18

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir Arthur Hurst: Harveian Oration.

ROYAL GEOGRAPHICAL SOCIETY (in the Connaught Rooms), at 7.45.—Annual General Meeting.

Thursday, October 21

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Sir George Lee: Presidential Address.

Friday, October 22

BRITISH ASSOCIATION (at the Royal Institution), at 5.—The Right Hon. J. Ramsay MacDonald, F.R.S.: "Science and the Community" (Radford Mather Lecture).

PHYSICAL SOCIETY, at 5.15.—Guthrie Lecture.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir John Thornycroft: Presidential Address.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICER at the Forest Products Research Laboratory, Princes Risborough—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1 (October 20).

TECHNICAL OFFICER AND ASSISTANT (grade III) for work in illuminating engineering at the Air Defence Experimental Establishment, Biggin Hill, Kent—The Superintendent (October 22).

PERMANENT ASSISTANT (male—grade III, metallurgy) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch) (quote C.E. 7851137) (October 23).

RESEARCH OFFICER (grade III) in the Agricultural Economics Research Institute, University of Oxford—The Secretary of the Committee for Rural Economy, School of Rural Economy, Oxford (November 1).

DIRECTOR of the Institute for Research in Agricultural Engineering, University of Oxford—The Secretary of the Committee for Rural Economy, School of Rural Economy, Oxford (November 15).

TWO ASSISTANTS in the British East African Meteorological Service—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, S.W.1.

JUNIOR ASSISTANT for abstracting and library work at the Imperial Bureau of Fruit Production, East Malling, Kent—The Deputy Director.

Official Publications Received

Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 59: Variation in Thickness of the Tin Coating of Tinplate, and its Effect on Porosity. By W. E. Hoare. Pp. ii+22. (London: International Tin Research and Development Council.) Free. [309]

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U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 7: Student Health Services in Institutions of Higher Education. By Dr. James Frederick Rogers. Pp. v+61. 10 cents. Leaflet No. 34: State Library Agencies as Sources of Pictorial Material for Social Studies. By Effie G. Bathurst, Elias Katz and Edith A. Lathrop. Pp. 9. 5 cents. Pamphlet No. 72: Status of Rural-School Supervision in the United States in 1935-36. By W. H. Gaumnitz. Pp. iii+20. 10 cents. Pamphlet No. 75: Safety and Health of the School Child; a Self-Survey of School Conditions and Activities. By Dr. James Frederick Rogers. Pp. 29. 10 cents. (Washington, D.C.: Government Printing Office.) [289]

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Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3547

SATURDAY, OCTOBER 23, 1937

Vol. 140

Lord Nuffield's New Gifts to Oxford

AN Oxford that had made up its mind not to be surprised by Lord Nuffield's almost daily giving to hospitals and other institutions was agreeably staggered last week to learn that the University had been offered by him approximately £1,300,000 for three important purposes. The first of these is the erection and endowment of wards in connexion with the Radcliffe Infirmary and the other hospitals associated with the School of Medicine, particularly the wards for the special use of the new Nuffield professors. The sum promised for this is £200,000, so that Lord Nuffield's endowment of the medical school within the past twelve months amounts to the munificent sum of £2,200,000. The second is the erection of the new laboratory of physical chemistry on a site between the Organic Chemistry Laboratory and the Department of Pathology in South Parks Road. For this a sum up to £100,000 is promised. The third and, to the general public, the most interesting, is the founding and endowment of a new college for post-graduate work in social studies, to be erected near Worcester College on the canal wharf that lies below St. Peter's Hall. For this, Lord Nuffield has given the valuable site itself, and a sum of about £900,000, about £250,000 of which will be required for the buildings.

The Oxford appeal launched last February aimed at £500,000 for definite and immediate needs, and a further £500,000 for the endowment of new developments in any subject that looks promising. It has now reached the sum of £423,000. As the physical chemistry laboratory is one of the immediate needs, this sum now becomes £523,000, and so as regards these needs the appeal has been successful. The first major step in the ordered development of the science area in the

Parks has accordingly been taken—to proceed with the erection of the new physics laboratory for Prof. F. A. Lindemann at a cost of about £80,000; and soon will follow the second, for which already provisional plans have been prepared—the erection and equipment of the University's first laboratory for physical chemistry with the sum given by Lord Nuffield, and the sums earmarked for it in the appeal fund.

The great majority of senior members of the University welcome these gifts as, of course, they deserve to be welcomed. A few complain that they will alter the character of the University considerably and, probably, for the worse; a few wish the offer had been entirely unconditional or, alternatively, that their own department or subject had been in the position of medicine, physical chemistry or social studies. As regards the last, it is realized that the success or failure of the new college will depend much on the start it gets and, in particular, on the first warden and fellows. A long and carefully drafted letter from Lord Nuffield to the Vice-Chancellor gives some ideas of the intended college and its fellows, and others have been got from some of the principal Oxford men who are concerned. The new college is to be mainly a post-graduate one, like All Souls', with accommodation for, say, fifty residents, and principally for research and investigation. It need not be entirely devoted to social studies; other subjects may be considered. It is not intended that it be a teaching institution in the ordinary sense or that it should train undergraduates for business careers, still less that it should be a place where the newly graduated may start to research according to their fancy. It is hoped that the fellows will be mature workers,

brought back after they have been out in the world for some years, to do large-scale team work on those social subjects on which research is urgently needed. The new college, it is hoped, will not merely be a centre for these activities in economics, politics, anthropology, sociology and the like, but also a place where men of business and affairs, by residing there, will have an opportunity of contributing their experience to the common fund. This co-operation of academic and

non-academic persons in attacking problems in the social sciences is regarded as valuable by those who, with Lord Nuffield and the Vice-Chancellor, have been thinking of the welfare of the new college. It remains to be seen how Oxford makes use of these gifts, which bring, of course, their difficulties and responsibilities with them. That it will rise to the occasion no one who knows the temper of young Oxford at the present time will question.

African Agricultural Problems

(1) Moisture and Farming in South Africa

By W. R. Thompson. (South African Agricultural Series, Vol. 14.) Pp. 260. (Johannesburg: Central News Agency, Ltd; London: Gordon and Gotch, Ltd., 1936.) 21s.

(2) The Earth Goddess:

a Study of Native Farming on the West African Coast. By G. Howard Jones. (Royal Empire Society Imperial Studies, No. 12.) (Published for the Royal Empire Society.) Pp. xii + 206 + 8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 12s. 6d. net.

THE great diversity of African agricultural problems is well illustrated by these two volumes. In South Africa moisture dominates the situation, and, on the west coast, anthropology.

(1) Mr. Thompson has assiduously collected a mass of information on the alleged drying up of South Africa and has critically examined the numerous explanations that have been advanced. They include the drying up of the inland Kalahari lakes, by head-stream erosion of rivers discharging into the ocean; the substitution of indigenous vegetation by exotic types such as wattle and eucalyptus with higher transpiration coefficients; the destruction of natural vegetal cover by veld burning, and the increase in cultivated crops, both of which are alleged to lead to increased evaporation from the soil and to erosion; and finally, the gradual rising of the earth's crust in South Africa, which in effect lowers the water-table and accelerates the run-off as the rivers cut deeper and deeper.

With the obvious exception of the last, all these theories predict a suitable remedy. The most widely known is Schwarz's scheme for greatly increasing the area of the inland lakes by dams across rivers that now drain the area. Although

Mr. Thompson patiently and fairly discusses this and rival proposals, he points out that discussion is somewhat academic unless the country is really drying up. He has examined this crucial question in great detail and can find no convincing evidence for the allegation. It is, in fact, the old story: the abnormal is noted and the account preserved just because it is unusual; and, in course of time, a series of such records presents a superficial appearance of normality to the uncritical mind. It seems clear that the popular idea that South Africa is drying up is not based on any evidence of change during historic times, but is an erroneous deduction from the peculiar meteorological conditions of the country. These may be summarized as follows: only 35 per cent of the surface receives more than 24 inches of rain annually; the total rainfall is variable, its distribution is unreliable, and it is markedly seasonal; the intensity is high and evaporation losses are heavy especially in summer-rainfall areas; the run-off is also high.

Evidently, rainfall imposes limitations on South African agriculture; droughts are common and losses severe. The cultivated land is also liable to extensive erosion, and Mr. Thompson discusses its increased incidence following more intensive farming practices, and urges the paramount importance of control measures, lest South Africa should follow the same unhappy path as other countries. No visitor to the country can fail to understand the concern that is felt about erosion dangers, for, whether he travels north from the Cape to Rhodesia, or east to Natal, the signs of drastic erosion are written large in those unique and beautiful panoramas that make a visit so memorable. The main strokes of this giant chisel cannot be stayed or altered; but the surfaces it leaves can be smoothed by the prevention of sheet erosion and gulleying on cultivated and

grazing land, and by the control of veld burning. Veld burning is a very old practice, and although at first sight indefensible is considered by responsible authorities to possess advantages that justify its judicious use as a part of veld management. It is often the only economical way of removing old fibrous vegetation of low feeding value; moreover, unburned veld often deteriorates after an extended rest.

Mr. Thompson supports the conclusions from his survey by data from his own experiments on transpiration, evaporation and erosion. These experiments would well repay further examination and separate development by soil physicists. Although the author stresses the tentative character of his conclusions, they carry conviction in all essentials. Farmers are now more numerous and farms are smaller; the present-day farmers are anchored to their land; they can no longer move their stock elsewhere during droughts as was possible only fifty years ago; the farming system must be adapted to the climatic conditions of the area instead of gambling on occasional good seasons; and finally, as efficient a vegetal cover as the climatic conditions allow must be maintained. The last point is most important, and one on which much more research is imperatively needed.

The book can be confidently recommended not only to agricultural scientists but also to the public, for it deals with matters that have a wide appeal. A more flexible style, an astute publisher to provide the right 'blurb', and it might easily have ranked with certain dissertations on relativity and the more speculative portions of astronomy as a best-seller.

(2) Mr. Thompson fluked his shot close to the bull; Mr. Howard Jones seems to have taken deliberate aim, but his score looks suspiciously like an outer. There are signs that the hope for popular success was at the back of his mind. The chapters have been forced into a musical analogy: the themes of the fugue; a digression on scale; the full-score fugue; a recital. The device is rather pointless and mildly irritating in its inevitable suggestion of pretentiousness. Two or three of the illustrations would be better omitted, and the absence of any photographs of native agriculture requires comment. The long account of rural organization in Denmark is unnecessary: as strong drink is to the dipsomaniac, so is the admittedly great achievement of the Danes to most amateur—and not a few professional—economists. The book would have been far better for a more objective treatment. The facts are interesting enough to speak for themselves, and wherever the author lets them do so, he holds the reader's attention.

Mr. Jones is a mycologist but, wisely, does not wish to work only in the narrow rut of a specialist. His book is a record of five years' experience of the agriculture of the west coast of Africa. There is an interesting if somewhat discursive opening chapter on Ala, the earth goddess, and the pervading influence of religious beliefs on the agricultural practices of the natives.

The author shows that much of what European observers would rightly classify as careless or worse, is explicable on historical and social grounds. The oil palm provides an excellent example. It has always been a standby of the native, providing oil, wine, kernels, thatch, string and ornaments, and in addition, now provides the main export revenue. So long as the West Coast had a monopoly of palm oil and kernels, the wasteful native methods of extraction did not matter. But a new standard has been set up by modern extraction factories elsewhere and, so far, the West Coast has not responded to this dangerous competition, mainly because of an overriding social problem. The present practice is that the men extract the oil from the fruit, and the women have the nuts, which they crack as a spare time job, selling the kernels for pin money; but the factory requires the complete fruit, so the men would receive all the money and the women nothing. That, as Mr. Jones says, would mean the destruction of a simple automatic system of domestic economy. When difficulties like these have to be met, the gospel of economic efficiency that is based on the standards of European industrial civilization loses most of its force and all its attraction.

Mr. Jones is at his best in discussing the immediate future of West Coast agriculture. He believes the planter system, and *métayage*, in which landlord and tenant each take an agreed share of the crop, to be less suitable than peasant farming. Although the nucleus of peasant farming already exists, the author recognizes and discusses the obstacles that must be removed to put it on an effective basis. Co-operation, the provision of credit facilities, education for the children, and the great difficulty of finding men who can combine the power of leadership with an understanding of the native outlook, are only a few of the problems. But the author believes that the choice of method in tackling the problems is as important as the problems themselves. He would impose a minimum of the direct methods which European administrators and technicians naturally adopt. The direct method is easier and will produce more material advance in a given time; the indirect course is slower, more difficult, and has only one virtue: it will take the people along their own natural road to the goal. B. A. KEEN.

Conditioned Reflexes and Psychology

Pavlov and his School: the Theory of Conditioned Reflexes

By Prof. Y. P. Frolov. Translated from the Russian by C. P. Dutt. Pp. xix + 291 + 16 plates. (London: Kegan Paul and Co., Ltd., 1937.) 12s. 6d. net.

FEW physiologists can read Russian, and most of them have to depend for their knowledge of Pavlov's work on reviews and summaries published in other languages. Two comprehensive books in English on conditioned reflexes were published in 1927 and 1928, and since then most of us have had to depend on scattered sources of information. The new book by Prof. Frolov is welcome because it gives a general review of the subject up to the time of Pavlov's death. We are indebted to C. P. Dutt for the English translation.

Compared with previous works it is short, and it is attractively produced, containing 26 illustrations and an account of Pavlov's life and methods of work. The author first met Pavlov in 1911, became a disciple, and himself made discoveries about conditioned reflexes. The book is written in a spirit of reverence for the master, whose methods are always right because they are always "physiological". These methods led to conclusions which did not always agree with the conclusions reached by those whose methods were not physiological, and it is evident that in the last ten years Pavlov devoted much thought to the relationship between his own conclusions and those of Freud, Kretschmer, Köhler and others. Pavlov recognized that many of Freud's results were similar to his own, and sometimes found Freud's conclusions helpful in the interpretation of his own results. He created a complex in a dog's brain, which was made to concentrate for two years on problems connected with a metronome and a trumpet. This complex interfered with the dog's subsequent reaction to a sound produced by a telephone receiver, which appears to have become symbolic of the trumpet. The complex was eventually cured, as Freud would have cured it, by a return to the trumpet. On the other hand, "the Ego and the Id . . . encountered the most energetic resistance and rejection on the part of Pavlov".

"Kretschmer's classification of nervous types, which has obtained almost universal recognition, especially among psychiatrists, must be regarded as mistaken or inadequate." Pavlov's classification, which is based on an experience of many thousands of dogs, is more complicated, but is

probably a closer approximation to the truth. Dogs are either strong or weak according to the ease with which they develop reflexes; they are either excitable, balanced, or inhibitable according to the relative strengths of excitation and internal inhibition; and both excitation and inhibition may be either labile or inert according to the ease with which they can be modified. This gives twenty-four possible types. This classification corresponds in some ways with that of Hippocrates. The choleric temperament is excitable, the melancholic inhibitable. The sanguine temperament is strong, balanced and labile, the phlegmatic strong, balanced and inert. The strong excitable type and the weak type were found to be particularly liable to pathological disturbances. These two types are thought to correspond to Kretschmer's manic-depressive and schizophrenic types.

Köhler's experiments with anthropoid apes have been repeated, and largely confirmed, in Russia, but his conclusions are "far from the order of thought of Pavlov". Tantalizingly, Frolov gives no details of Pavlov's interpretation of these results, but contents himself with the statement that it is essentially different from, and at the same time simpler than, Köhler's interpretation. Further discussion of this point would presumably have thrown light on what seems to many to be the chief obstacle to those who seek to explain all behaviour in terms of reflexes—the question of intelligent behaviour. This question is briefly discussed in another part of the book. A dog which had been fed whenever its paw was held in a slightly flexed position not only developed a salivary response to the proprioceptive sensation of having a flexed paw, but also deliberately flexed its paw when it saw the experimenter. This response is attributed to the establishment of a well-beaten track from the proprioceptive area of the cortex to the food centre along which impulses eventually pass in the reverse direction so that excitation of the food centre causes movement. When flexure of the paw was followed by the pouring of acid into the dog's mouth, the sight of the experimenter caused extension of the paw. Frolov gives no clear explanation of these facts, and his statement that as a result of these experiments "the mechanism of voluntary movement, at any rate in animals, was for the first time clearly revealed", is unconvincing.

It is possible that the reinforcement of the action which has been followed by food is comparable with the development of reaction in a

circuit containing a thermo-electric valve. In the electric model the amplified electric changes are reintroduced to the valve, and so travel round a circuit, being amplified again and again. In the same way one might suppose that the excitation of the food centre by the presence of the experimenter causes a sub-threshold excitation which spreads over the whole cortex. When this excitation reaches the area corresponding to the movement which has been followed by food, the conditioned reflex increases the excitation of the food centre, and this excitation then reinforces the excitation of the centre corresponding to the appropriate movement because that centre is

already excited. The impulses thus travel round a circuit until the excitation rises above its threshold value in the motor centre, and the appropriate movement is made. In order to explain the response to acid, one might suppose that the presence of an experimenter who was accustomed to place acid in the dog's mouth excited a defence centre which, besides causing salivation and other defence actions, caused sub-threshold inhibition to spread over the cortex, and to be reinforced in the same way as the excitation spreading from the food centre. Such a mechanism would account for a great variety of intelligent actions.

J. H. GADDUM.

The Science of Astrology

Dekane und Dekansternbilder :

ein Beitrag zur Geschichte der Sternbilder der Kulturvölker. Von Wilhelm Gundel. Mit einer Untersuchung über die Ägyptischen Sternbilder und Gottheiten der Dekane, von S. Schott. (Studien der Bibliothek Warburg, herausgegeben von Fritz Saxl, Band 19.) Pp. x + 452 + 33 plates. (Glückstadt und Hamburg : J. J. Augustin, 1936.)

IN the Warburg Library, still all too little known, London has an important centre of curious learning. Great erudition backed by ample means went to the making of it. Dr. Warburg's hobby was to study the countless survivals of ancient religion in modern faith and symbolism, and his great library grew up around this fine farrago of learning. The library is organized and arranged with exceptional skill, its doors stand open to every scholar, and its books are only waiting to be read. It publishes studies of its own under the general editorship of the learned librarian, Dr. F. Saxl, and one of these, a volume of more than four hundred pages, lies before us. It is by a well-known student of ancient astronomy, Dr. Wilhelm Gundel of Giessen, and it deals with the 'decans' and their stars, a subject dear to the heart of the founder of the Library.

What is a 'decan' ? When the year (of 360 days) had been divided into its twelve months and put under the zodiacal signs, each of the twelve was again divided into three parts, of ten days each ; and these thirty-six 'decans' had their thirty-six gods, or rulers, or dynasts, watchers of the hours ('horoscopes'), servants or messengers of the greater gods, or of Horus himself in his holy name spelled with thirty-six letters ; each had his own 'face' or πρόσωπον, which might chance to be

(in Egypt) the face of a bull or of an ibis, or of an eagle or of a man. These were the angels and archangels, the demons and archi-demons, of Hellenistic writers. Each had his own name ; in mummy-cases and papyri, in obscure and fragmentary works like *Hermes Trismegistus* or the *Testimonium Salomonis*, in Celsus and Firmicus, in the traditionary learning of men like Kircher, Salmasius or Scaliger, we find the names of Chont-har, Chont-chre, Siket, and the thirty-three others, in all kinds of variants and corruptions. Egyptian they were in the beginning, but the true form and meaning of many are long lost. These names form a large part of astrognostic science, but they are very hard to discover ; for the simple reason that the demon had to do the bidding of whomsoever called him by his name, and he took great pains to hide it !

The decans play their part in every aspect of astrology. A man's body, always a microcosm of the heavenly body, had its thirty-six parts each under the governance of its god or demon, and the knowledge of these formed the science of *iastro-astrology*. The decans had their place in magic and in prophecy ; they ruled the weather, and it was in the first decan of the year that Sirius brought about the inundation of the Nile ; heaven itself was divided into thirty-six regions, and earth, once again a microcosm, had its corresponding mystical geography. A man's life was ruled by his 'horoscope', for in the instant of his birth he assumed the qualities and came under the rule and guidance of the god or demon of his decan : as Manilius has it, *cujus signi quis parte creatur, Eius habet mores atque illo nascitur astro*.

Nothing can be more unlike what we now call science ; but almost all our science is but of

yesterday, and this astrology occupied the minds of men of learning for some four thousand years. Scaliger was an astrologer in his younger days, and was the last of the great scholarly astrologers; for astrology came at last to its death-bed, in the century of Galileo and of Newton. There must be many a thing in antiquity which we should all the better understand with some help from a science so ancient and so universal; and every now and then the study of the decans throws light into strange and unexpected places. There can be little doubt (and I have none) that these rulers of the decans are no other than the genii or daemons in whom Socrates so firmly believed, whom "God, in His love of mankind, placed over us to take care of us and give us peace"—words which recall still more familiar words, "He shall give His angels charge concerning thee".

We know the story well of the man whose child

was lunatic and sore vexed, and how the devil threw him down and tore him. "Sometimes he falleth into the fire, and often into the water"; and just so we read in the astrological texts that the demon of the seventeenth decan would lay hold of a man in his bath, or cast him to the ground. It happens that this decan was associated with Thoth, as a moon-god, and we know that the epilepsy from which the child suffered was a 'lunacy', or moon-disease. Jesus rebuked the devil, and he departed out of him. "He was of a kind that goeth not out but by prayer and fasting"—that is to say, by the appropriate formula and the ascetic life of the exorcist.

Dr. Gundel has written an admirable book, beautifully illustrated. It will take its place by Bouché-Leclercq's "Astrologie Grecque", and a few other similar works of exceptional learning.

D. W. T.

The Theory of Metals

The Theory of Metals:

based on an Essay awarded the Adams Prize in the University of Cambridge, 1931-1932. By A. H. Wilson. Pp. viii + 272. (Cambridge: At the University Press, 1936.) 18s. net.

THIS careful study of the electron theory of metals is intended in the first instance as a critical survey of the general principles of the theory and of the approximations made in working out its applications. No attempt is therefore made to give a full account of the applications of the theory to individual metals, and such applications as are given serve as illustrations for the use of the general methods.

Such a critical investigation is highly desirable in a field in which, owing to mathematical complications, one could until quite recently find different results derived by different authors from the same assumptions. Mr. Wilson's book was awarded the Adams Prize for 1931-32, but it has been brought up to date by taking into account a great deal of literature published since then.

The book starts with a historical introduction, giving an outline of the old Lorentz-Drude theory of metals, together with Sommerfeld's theory, which is based on Fermi statistics and free electrons. This chapter also contains a commendably clear definition of the notion of a 'mean free path', and it is made quite clear that a mean free path in this sense need not in every case exist.

Chapter ii discusses the influence of the periodic field of force on the motion of the electrons, while

the following chapter deals with the applications of this general theory to equilibrium properties of metals, such as the electronic specific heat, the distinction between metals, semi-conductors and insulators, cohesion forces, magnetic properties and the like. The optical properties are separately treated in chapter iv, while chapter v treats the electric and thermal conduction on the assumption that a mean free path exists. For simplicity it is further assumed that the mean free path is independent of the energy. While this simplification is unimportant for most of the formulæ obtained, it is of considerable importance in the formulæ for the thermo-electric coefficients, and it is regrettable, therefore, that it was not stated explicitly.

The main question as to the existence of a mean free path and its order of magnitude is taken up in chapter vi. It is made clear why a mean free path exists at temperatures above the Debye temperature Θ of the crystal lattice and that it does not exist for lower temperatures. The usual methods for calculating the mean free path at high temperatures and the electric and thermal conductivities at low temperatures are summarized and their validity is discussed. On this point, Mr. Wilson is (one may hope, unduly) pessimistic. He finds an objection to the usual Bloch calculation of the conductivity at low temperatures and shows that a more rigorous calculation would not lead to reasonable results for the conductivity if one retains the assumption that the electrons in the metal are very nearly free. He thus concludes

that this assumption ought to be abandoned, but he is very reluctant to do so, because this would mean abandoning many calculations which have led to results in good agreement with experiment. One may hope, however, that these calculations depend less on the assumption of free electrons than it would appear; the results that are confirmed by experiments are mostly qualitative, and one may hope that they can be reproduced without making use of that assumption. However, that is a point at present unsettled, and even a reader who does not share Mr. Wilson's pessimism as to the future fate of the theory will find his account of the existing theory of low-temperature conductivity clear and correct.

The last chapter gives an account of superconductivity, a field in which there is little theory

to report upon, except for thermodynamical relations. These are derived, together with a brief description of the experimental facts. An appendix contains two derivations of the fundamental formulae of Fermi-Dirac statistics and a discussion of surface phenomena such as thermionic and cold emission and contact rectifiers.

The treatment throughout the book approaches more closely to rigour in the mathematical sense than most other physical monographs. It is likely to provide, therefore, a pleasant change for the more mathematically-minded reader, while in general it gives enough of the physical argument to be understandable to the physicist.

A list of symbols and a very complete subject index are very helpful for reference to special points.
R. P.

Gem-Stones

The Story of the Gems:

a Popular Handbook. By Herbert P. Whitlock. Pp. vi + 206 + 34 plates. (London and New York: Putnam and Co., Ltd., 1937.) 15s. net.

AS the title and sub-title sufficiently indicate, this new book on gem-stones has not been written for the student or specialist but primarily for the ordinary man and woman. The author has been for many years curator of minerals and gems in the American Museum of Natural History, and his experience in that position has helped him to realize the type of information about gems that is most desired by the intelligent layman. The book thus touches only very lightly on the scientific aspects of the subject, and there are none of the explanatory chapters on crystal form, hardness, refraction, etc., which are usually to be found in even elementary texts.

In the introduction, however, brief instructions are given for the measurement of specific gravity by the hydrostatic and pycnometer (here curiously misspelt 'picrometer') methods, and for the detection of double refraction in faceted stones with no apparatus beyond a white card or a pocket lens. Only American gemmologists seem to mention the sunlight-and-card test for double refraction—possibly because in the United States sunlight is a less fugitive commodity than in north-west Europe. Since, however, not only sunlight but any beam of parallel light can be made to serve, this simple and sensitive test merits wider recognition over here. It would have been well also to include the Mohs scale of hardness, since an acquaintance with this is assumed in the many references to hardness later in the book.

The main part of the book opens with a chapter on the antique use of gems, followed by an interesting and unusually full account of the cutting and fashioning of diamond and other stones, illustrated with line drawings and photographs. This is probably the most valuable part of the book.

The remainder of the volume is mainly occupied with descriptions of the various mineral species used as gems, starting, as usual, with diamond, and ending with chapters on opaque and ornamental stones and on 'unusual' gems. The treatment accorded to some of the more important gem-stones is decidedly meagre—ruby, spinel, and zircon, for example, receive an allotment of barely two pages apiece.

Simple means by which stones of similar appearance may be distinguished from one another are in most cases indicated in the appropriate context.

A list of books on gems (in which Eppeler's "Edelsteine und Schmucksteine" and Spencer's "A Key to Precious Stones" should certainly have been included), and descriptive tables giving the composition, chief localities and characteristics (except refractive index) for each species in alphabetical order conclude the book. An index is provided.

The work is copiously illustrated from photographs of gems and carved objects from the Morgan collection and there is a double frontispiece in colour of cut specimens to which frequent reference is made in the text. Though not entirely free from small errors and omissions, it provides a well-written and extremely readable account of the subject, and should help to spread a knowledge and love of gems among the general public.

B. W. A.

Temperatur, Salzgehalt und Dichte an der Oberfläche des atlantischen Ozeans

Lief. 1: Das Beobachtungsmaterial und seine Aufbereitung. Von Günther Böhnecke. Pp. iii+186. 27 gold marks. Atlas. Pp. vii+74 plates. 37 gold marks. (Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition auf dem Forschungs- und Vermessungsschiff *Meteor* 1925-1927, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft, von A. Defant, Band 5.) (Berlin und Leipzig: Walter de Gruyter und Co., 1936.)

THE temperatures on which this work is founded were observed for the larger part by merchant ships. A very large proportion were collected and partly worked up by the Royal Netherlands Meteorological Institute; the Danish Meteorological Institute, the German Seewarte and the charts published by the Meteorological Office in London with the reports of various expeditions were the sources of other material. For the area from 50° N. to the Antarctic, about 1,400,000 observations were used. The observations of salinity available were so few that it was necessary to use the earlier ones made with the hydrometer; a table of sources gives the method by which they were reduced to modern standards. This table contains 176 entries, some of which cover many ships, and should be useful for reference. The chief table gives the mean temperature and salinity for each month and one-degree square.

The results are not discussed in any way, but are shown in an atlas of beautifully printed charts. There are four charts in black and white showing the distribution of the observations, then follow thirteen in colour giving the mean temperature for the year and each month. Other charts show anomalies and yearly range. Observations of salinity are too few to allow of charts of mean values being drawn for the whole ocean for periods less than three months, but monthly charts for the North Atlantic Ocean are included. There are also charts showing anomalies and times of maximum and minimum, with a complete set for surface density.

These two volumes make an extremely valuable work of reference, and there are few questions as to the surface temperature and salinity which could not be answered by their aid.

The Chemistry of Natural Products related to Phenanthrene

By Prof. L. F. Fieser. (American Chemical Society Monograph Series, No. 70.) Second edition, with Appendix. Pp. xiv+456. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 35s. net.

A REVIEW of the first edition of this important treatise appeared in NATURE last year, and already a second edition has become necessary. The opportunity has been taken to add a 90-page survey of relevant papers of 1936, each referred to its appropriate context. The appendix with the revised index may be obtained separately, so that the first edition is not devaluated. The wisdom of adding so large an appendix is doubtful, since abstracts of the three

hundred papers cited are available, but references to certain real advances of 1936 could not well have been omitted. Several simple carcinogenic compounds, notably *o*-aminoazotoluene, have been discovered, and the range of oestrogenic substances has been considerably extended. The animal organism has been found to synthesize polyterpenes; and the first chemical transformation of cholesterol to a natural bile-acid has been realized. Outstanding has been the isolation of natural vitamin D and its identification with the irradiation product of 7-dehydrocholesterol. Certain crystalline substances from the adrenal cortex have been found to possess close structural relationship to the sterols. Moreover, the year has witnessed steady increase in knowledge of the stereochemistry of the sterols and sex hormones, and of the structures of the cardiac glycosides.

(1) **Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance**
By Arthur W. Judge. (Motor Manuals, Vol. 1.) Third and revised edition. Pp. 301. 5s. net.

(2) **Car Maintenance and Repair**
By Arthur W. Judge. (Motor Manuals, Vol. 4.) Second edition. Pp. xii+283. 4s. net.

(3) **The Electrical Equipment and Automobiles: a Book on Principles for Motor Mechanics and Motorists.** By Prof. Stanley Parker Smith. Third edition, revised and enlarged. Pp. xii+250. 6s. net. (London: Chapman and Hall, Ltd., 1936-37.)

(1) MR. JUDGE presents the elementary principles of the petrol engine together with a comprehensive description of the various types used in automobiles. A chapter is devoted to the heavy oil engine, and considerable space is given to the lubrication, cooling and testing of petrol engines of all types. The text of the book is well written and adequately illustrated, and the subject-matter has been made interesting by a judicious and versatile selection of examples from modern British practice.

(2) The text of this book is clearly presented, with some 200 useful diagrams, and forms a good introduction to garage technique for the motor-car owner who desires to carry out much of his own maintenance work. The scope of the book is necessarily limited to one or two types of motor-car, and from some points of view it may be considered that the book is intended to be merely supplementary to the appropriate illustrated handbook usually supplied by the motor-car manufacturer with each model sold.

(3) This is the third edition of a book written primarily for students undergoing a course of instruction in the principles and practice of motor-car engineering. The book has been thoroughly revised and considerably enlarged in order to include the extended application which electricity now plays in the modern motor-car. It is comprehensive and thoroughly reliable, and it should prove valuable to the motorist who takes an intelligent interest in his car, as well as to the class of student for whom it was written.

In the Realm of Mind:

Nine Chapters on the Applications and Implications of Psychology. By Dr. Charles S. Myers. Pp. v + 251. (Cambridge: At the University Press, 1937.) 7s. 6d. net.

THE appearance of a further volume of semi-popular papers on psychological subjects by Dr. C. S. Myers, just before the recent meeting of the British Association, was an inevitable reminder of the part he has played in securing the recognition of psychology as one of the sciences. As far back as 1913, it was so recognized by the British Association to the extent of its being made a sub-section under physiology. Not until 1920 was it accorded the rank of a section, and from 1922 to 1931 Dr. Myers was president of that Section.

It is fortunate for a subject which has been called—even by one of its distinguished representatives—no science but only the hope of a science, that so true a man of science as Dr. Myers has had a large share in guiding its destinies. His great work, not only as an experimental psychologist, but also as our national leader in the practical application of psychology to industrial and other problems, is too well known to call for special remark in this place. Readers of his former volume entitled "A Psychologist's Point of View" will not be likely to miss this new collection of papers. They cover a variety of topics—the choice of a career, the human factor in accidents, medical education, social psychology, internationalism, psychological conceptions in other sciences, and the nature of mind. But all this variety is consistent with a unity which comes of a common point of view. This is just the kind of book and just the kind of treatment calculated to convince any reasonable person that psychology is unquestionably a science.

(1) **Biochemistry Applied to Malting and Brewing** By Prof. R. H. Hopkins and B. Krause. Pp. 342. (London: George Allen and Unwin, Ltd., 1937.) 12s. 6d. net.

(2) **Practical Management of Pure Yeast: the Application and Examination of Brewery, Distillery and Wine Yeasts.** By Alfred Jörgensen. Third edition, revised by Albert Hansen. Pp. xii + 111. (London: Charles Griffin and Co., Ltd., 1936.) 6s.

MANY famous names in the past have established the tradition that chemical research is an essential part of brewing practice. It is desirable, therefore, that a proper training in biochemistry should form the basis of the education of the would-be brewer and that the text-books available for the students be of high standard.

(1) The book under notice is largely a translation from the Danish of a book by Krause to which Prof. Hopkins has given an English aspect. It falls into two sections—one chemical, the other largely practical. The former is on the whole unsatisfactory, though the difficulty of compressing the necessary chemistry into a few pages must be allowed for. Probably it is best to separate the two subjects and

teach the student his chemistry on orthodox lines. The more practical portion written by a man who knows his subject is excellent: the work should prove useful.

(2) In the yeast field the name of Jörgensen of Copenhagen stands high: no one has done more for the subject in practice and as a teacher. A third edition of his little practical handbook, revised by A. Hansen, is assured of a welcome.

Military Engineering

Vol. 6: Water Supply. (War Office.) Pp. 421 + 171 plates. (London: H.M. Stationery Office, 1937.) 10s. net.

THE volume on water supply, issued as a manual by the War Office, is a comprehensive survey of the subject in which, naturally, predominance is assigned to those aspects of the matter which affect military operations. At the same time a very useful summary is given of general principles, and the essential facts relating to water supply, whether civil or military, are set out with commendable directness and precision. There are fifteen chapters, covering water supply requirements; reconnaissance of sources and measurements of yield; well-sinking and -boring; reciprocating and centrifugal pumps; water elevators and pumping by compressed air; selection, installation and operation of pumping plant; storage; water analysis; principles of water purification; water purification practice; distributing systems, water points and water transport; field supplies during mobile operations; field supplies during protracted operations; water supply calculations and examples of camp supplies. A number of tables, plates and figures, with seven appendixes and an index, help to make up a very serviceable manual for general use.

In the compilation within reasonable limits of such a variety of information, there is naturally scope for difference of opinion on certain points, such as the statement on p. 42 that "in searching for suitable sites for shallow wells and tube wells, the employment of dowsers, or water diviners, may save time and possibly fruitless labour in well sinking". B. C.

Health and a Day:

Addresses. By Lord Horder. Pp. viii + 213. (London: J. M. Dent and Sons, Ltd., 1937.) 7s. 6d. net.

THIS volume consists of twelve addresses delivered during the last two years before medical and lay audiences in Great Britain and the United States. Six of the addresses were given before medical gatherings, but only two, entitled "The Clinician's Function in Medicine" and "Direct Action in Medicine", were specially intended for the medical profession. Other addresses deal with the strain of modern civilization, the doctor as humanist, the doctor's place in society, the Hunterian tradition, national health, old diseases and new, and euthanasia. Although several of the addresses have been published before, the pleasant conversational style, and the eminently sane opinions expressed by one of the most distinguished London physicians, should secure for the work a wide circle of readers.

Tendencies of World Power Development

By Dr. E. F. Armstrong, F.R.S.

IN the modern world the question of natural power supply becomes more and more important. There is the tendency, not by any means confined to power alone, to exploit national resources and to make these available even if they are uneconomic. Power resources are of two kinds: those which are limited, including coal, oil, natural gas, peat, oil-shale; and those which are perpetually renewed, such as water, wood, wind or even the tides. A recent analysis shows that for 1935 the world power supply consisted of 56.6 per cent coal, 3.7 per cent lignite, 16.5 per cent oil, 3.8 per cent natural gas, 12.8 per cent firewood, 6.6 per cent water.

The proportion derived from coal has been stationary over the last four years, but has gone back materially since 1913; that from oil and water has increased. The consumers of power take little heed that these resources are limited, and the less wasteful use of recent years has been in the main imposed by increasing cost. Modern technique does aim constantly at a reduction of the amount of power used per product or per working unit, a factor which must tend towards a decline in the total consumption of power unless the trend of general industrial development is upward. This growth will determine in the future whether the production and consumption of fuel will rise slowly or rapidly.

In Great Britain during the last twenty-five years the gas industry has increased its yield of gas per ton of coal by more than 27 per cent: it is unlikely, however, that this figure will improve further. In the electrical industry the increase has been more than 130 per cent per unit of weight: substantial technical economies and improvements are being effected. The chief cause of the decrease in home consumption of coal is shown by the statistics to be due to the diminished use in blast furnaces and steelworks owing to more efficient methods of production. The coke consumption per ton of pig iron actually stood still for forty years at 40 cwt. per ton—to-day it is down to 33 cwt. per ton of pig. For steel the corresponding figures are a fall from 37.8 cwt. in 1920 to about 21 cwt. to-day. There is still more to be done in this direction in almost every industry; moreover, the change will be accelerated by the largely increased price of coal.

There are thus strong reasons for a decline in consumption of coal even with accelerated industrial development.

Actually the protection of oil and coal resources will first be attained when these materials cease to be squandered and are used only in the form of 'residual products' after more or less extensive chemical changes.

Coal resources are variously estimated as lasting some hundreds or even thousands of years; the mineral is becoming increasingly costly to mine. Oil resources at the present rate of consumption are given only a very short life. Water resources are in a sense inexhaustible, but it must be remembered that in the more advanced countries the most accessible falls are already developed, and that in consequence every expansion of water-power meets with more unfavourable conditions and therefore involves high costs of development. About 35 per cent of the total electric current generated is hydro-electric.

It is difficult to say in assessing the competition between coal and water-power which of the two is the cheaper: this largely depends on the continuity of the load. It is stated, for example, that the kilowatt hours produced in steam plants or water plants cost the same on an average yearly performance of 3,000 hours, water-power being cheaper above and steam-power being cheaper below this factor. The most satisfactory modern development aims at establishing a combined use of water-power and steam-power: it is preferable to use them to supplement one another rather than in competition. There is still ample water-power available in the world, only 55 million h.p. being so far developed out of 470 million h.p. available. One of the factors with electricity produced by water-power in remote places is its economic transportation with a minimum of loss to the point where it is used. Should industry, however, be thrown back more largely on water-power, it would mean a transference of manufacturing plants to countries or localities where this is available. For this reason, there are many who regard Canada as having great potentialities as a manufacturing country.

Oil competes with coal for motoring and for the aeroplane, both new uses for which there is no alternative source of power, and for shipping—this last turnover constituting a serious loss to coal. Its use for transportation and general purposes is regionally limited. The development of the competition is influenced far more by the price of oil derivatives than by that of crude oil, and it appears likely that the advance in the use of

synthetic oils having special and valuable properties will in the long run involve their production from coal even at a higher cost. The purely economic point of view alone will not be sufficient to prevent this development as it does to-day—military, political and fiscal points of view are likely in the near future to make the advent of oil from coal nearer than is generally believed.

Whereas in the United States coal only makes up half of the power production, in Germany it is necessary for 90 per cent. Hence Germany is forced to make oil from coal, the more so as in times of peril she will have no easy access to world supplies without command of the sea.

The position in Great Britain is an intermediate one; with no natural oil we are staking everything on the command of the sea and the ability to continue supplies of oil on an enormous scale. To-day, as for many years past, our industrial supremacy is based on coal.

In any event, under present-day conditions, crude oil production can scarcely keep step with the rate of increase in demand. The share of the United States has declined, though the production of Venezuela, Rumania, Iran and Iraq has assumed greater importance.

There is always a change in the particular oil product required: thus the proportion of gasoline (petrol) to crude oil has risen from 7 per cent in 1913 to 35 per cent in 1931, since when it has slightly declined as the production of heavier gas

oil has increased. The position of oil supplies twenty years hence is obviously one of uncertainty.

In England, where the wood resources are so small, it comes perhaps somewhat as a surprise that 12·8 per cent of the world power supply is produced from wood, the equivalent figure in 1913 being 17·6 per cent. In heavily timbered countries, however, both on the continent of Europe and abroad, wood is still of prime importance. The forests which cover so much of northern Quebec represent to-day what the English Lake District must have looked like before the trees were felled—largely to smelt copper—in the time of Elizabeth: the oft-related destruction of the Sussex woods to smelt iron ore before the discovery of sea-coal is another parallel of what is happening abroad to-day. Scientific attempts are being made to utilize wood and its products in the best manner for a variety of purposes connected with power production and also as a raw material for the paper industry. Actually about half the total wood cut is used as firewood—a quantity estimated at 680 million cubic metres.

At the turn of the nineteenth century, coal seemed to dominate the field and to have pushed all other sources of power into the background. To-day coal, oil and water compete: the situation is determined in the various countries by conditions which have relation to factors not purely economic.

Modern Study of Plants in Relation to Education*

By Prof. E. J. Salisbury, F.R.S.

FROM the cultural point of view, plant life and all that it implies may be regarded as the foundation of a vast extent of human activity and the basis of a large and essential part of every human environment. Because neither we nor the animals could persist without plant life, it follows that much of the present distribution of these organisms over the face of the earth can only be understood in terms of the plant life either of the present or the past. Even man's industrial activities have been largely localized and in part determined by the geographical distribution of vegetation, whether it be that of the forests, of perhaps 280 million years ago, which gave origin to our coal deposits, or the vast extent of grasslands that have determined the location of pastoral communities.

A realization of the widespread demands made upon plant products would probably astonish

many of those who, like Mr. Babitt, find in the mechanistic devices of the age their chief delight. Yet it has been recently estimated that a thousand Ford motor-cars utilize in their manufacture the entire plant yield of more than six hundred acres, and this quite apart from the indirect demands for grazing necessary to furnish the materials of animal origin. Despite the vast areas of the earth's surface devoted to the growth of foodstuffs, of textile fibres, of timber, rubber, tea, tobacco and innumerable other plant products, the plant remains perhaps the least known and appreciated of all man's servants by those who lay claim to any cognizance of their environment.

* Even the town dweller can scarcely fail to recognize the indirect contacts of his everyday existence with the activities of agriculture, forestry and horticulture, and, if education is to be interpreted as a means of enabling the individual to

*Continued from p. 671.

have an intelligent appreciation of and harmonious relations with his environment, then a knowledge of plant life is manifestly essential to that end. I should almost feel that an apology was necessary for expressing sentiments so trite were I not sure that whatever agreement there may be in theory, our educational curricula bear witness to the neglect of these principles in practice.

The increasing diversity of pursuits in a progressive science is only too liable to be accompanied by an increasing detachment of interests and divergence of expression. Specialization, which should be accompanied by greater co-ordination, is only too frequently the begetter of disintegration rather than synthesis, and the mutual interdependence of one branch on another is lost sight of. One of the main purposes which the British Association should serve is to promote the co-operation between workers in different fields. But we only come together for a short week in each year, and so it is to the universities that we must look mainly for the continuous fostering of a liberal outlook both on science as a whole and within the domains of each particular subject.

In its earlier phases, botany was naturally concerned largely with description, and in such branches as taxonomy, morphology, anatomy, cytology, mycology, palaeobotany and plant geography the descriptive aspect must necessarily play an important part, just as in ecology, physiology, bacteriology and genetics the experimental aspects should predominate. But in all, the cultural value can only be maintained if form and function are closely integrated. Each branch has its own contribution to make in this respect not only to the pure science but also to its applied aspects in agriculture, horticulture, pomology, silviculture and plant pathology. The mere enumeration of these branches, whether pure or applied, envisages the richness of the field we cultivate and the extensive contribution that botany can make towards both the enrichment of the human mind and the well-being of the race. But the accumulation of data in these varied directions of inquiry will only fulfil its full purpose if the many threads are continually woven into the warp and woof of a single fabric.

The retention of plant physiology within the domain of botany has saved us from the worst evils of the study of form unrelated to function. This has also been one of the chief factors which led to that synthetic approach to our subject which concerns the relation of the plant to its surroundings. The supreme value of ecology, however, lies not so much in the attention which it focuses upon the mutual relations of organisms or even upon their relation to the environment, but in the synthesis which ecology achieves, into a

single picture, of so many aspects of botany itself and so many branches of human knowledge. Its high educational and cultural potentiality is an outcome of the fact that it is the very antithesis of that common failing of the human mind to think of different subjects as isolated compartments of knowledge and not as different facets of one and the same jewel.

When we attempt to understand any plant community, the necessary study of the physical environment leads us at once into realms of soil structure, into the physical problems connected with water retention and water movement involving colloid properties and surface action. So, too, the chemist and the meteorologist make their contributions to our concept of the habitat, whilst the bacteriologist, the mycologist and the protozoologist all help us to envisage that teeming population of bacteria, fungi and protozoa in the soil which, by their proper balance, maintain a healthy circulation of chemical products and are a necessity for the maintenance of the supply of raw material for the higher plants and animals.

Since the environment of the present is in some considerable degree the consequence of that of the immediate and sometimes of the remote past, the study of external conditions brings us into contact with the contributions of glaciologists and historians, whilst even the student of 'place names' may materially assist in the reconstruction of those past conditions that in part have determined the present state.

When we turn from the study of the habitat to that of the vegetation which it supports, we are at once confronted with the question as to the extent to which one is in equilibrium with the other.

The morphologist and the anatomist furnish the data upon which we base our judgment as to the degree to which the external form and internal structure have contributed to render the organisms suited to the environments that they frequent. In so far as there is adaptation, whether passive or active, in this respect, to that extent the community is in equilibrium with its surroundings and represents a climax, subject, it is true, to secular change but of a relatively stable character.

The contribution of the systematist is to distinguish between the more critical species and races which exhibit a localization that less meticulous examination might readily ignore and which often have an ecological importance far greater than the Linneons of which they are the segregates. The experimental conclusions of the physiologist in the laboratory must be applied by the ecologist to the elucidation of problems in the field, complicated and often profoundly modified

by the continual operation of the competitive factor.

Finally, knowledge of the life-histories of the constituent organisms, the reaction of the various phases of their development to the environment, their modes of reproduction, their establishment and extension, comprise a mass of knowledge to which many astute observers have contributed and amongst whom the amateur holds an honoured place in our esteem. The *clichés* of the politician with regard to policies could be applied with far more than their usual significance to the ecologist, who might with some reason be described as "exploring every avenue" and "leaving no stone unturned" in his attempt to reveal the causal relations underlying the social organization of plant life; but this all too brief résumé of the contents and contacts of a single branch of botany has, I hope, sufficed to emphasize that the wide range of knowledge invoked by the ecological approach, though constituting its chief difficulty, is the very basis of its cultural value, since it weaves together into a comprehensive whole so many threads of knowledge spun by the specialists upon the wheels of research.

The value of such approach is also obvious in relation to everyday affairs. In any well-considered plan of land utilization of catchment areas the ecological aspects are apt to be ignored. The land surface under its various guises may be likened to a sponge which absorbs the divers forms of precipitation and allows the water with more or less rapidity to find its way into the streams and rivers. But the effectiveness of the land surface for holding back the water varies according to whether it is under high forests, scrub, grassland or is arable. Each type of plant cover has its own absorptive factor and its own resistance to erosion. Furthermore, each vegetation type is not static but dynamic, and its role in this respect changes both with the seasons and with the passage of time. If therefore our land utilization is to be properly conceived, due regard must be had to the proportions in which the various communities, whether natural or artificial, are present. If we are to avoid floods and droughts, we must preserve rural England for practical, as well as æsthetic, reasons. To all this ecologists can contribute valuable help, the more so that with the passage of years the surface of our roads has become better and less absorbent, and our ditches are kept cleaner so that drainage to rivers has generally become more effective and rapid. Hence what sufficed to restrain extreme conditions a hundred years ago would not suffice to-day. Afforestation of the catchment area of the Thames and other rivers would, in the long run, be perhaps far more effective and less costly as a guarantee against

future floods or droughts than grand-scale engineering works, and whilst the former would produce ancillary assets of great value the latter would not.

Prof. F. W. Oliver pointed out, in reference to the reclamation of foreshores, that the plastic plant can and does meet the constantly changing impact of the forces of Nature in a way which the dead material of the engineer cannot hope to emulate, and at a far lower cost. But such biological control demands not only a comprehensive knowledge of the life-histories of the species utilized, but also an appreciation of the environmental factors, dynamic as well as static, that is summed up in the phrase ecological foresight.

Another matter is the much-discussed question of the preservation of natural areas. Owing to the widespread ignorance of biological knowledge, the dynamic character of vegetation is by no means widely realized. There are indeed many educated people to-day who think that to preserve an area all you need to do is to leave it alone. The fact that our open downland, presented to the National Trust, may, if left unhindered, ultimately cease to be downland and become woodland, with the loss perhaps of the very features for which the area was preserved, is for most a novel concept. But an enlightened policy of such control of national reserves and all that this implies will only be possible if the rising generation has been inculcated into a biological mode of thought.

It is probably true to say that no branch of botany could be cited that has not its important practical applications. Botany needs no defence in respect to the practical utility of its pursuit, although it is probably true to say that the majority of those who reap the benefits of its achievements are unmindful of their source. But it is, I feel, the contribution that botanical knowledge can make towards general culture and spiritual contentment that is its chief claim to rank high in our educational scheme.

A sympathetic understanding of botanical thought and progress is essential to a community which is to deal adequately with such national problems as agricultural policy, land utilization, afforestation, drainage and water supply, the preservation of rural areas or the provision of national parks. Only on the foundation of a knowledge of plant life and its requirements can an educated public opinion be built up that will receive and give effect to well-considered legislative action. Moreover, it is perhaps truer of these pressing questions than of most that a sympathetic and informed public opinion is essential to the continued effective operation of any policy however well conceived and enlightened.

Congrès du Palais de la Découverte

International Meeting in Paris

WHEN the President of the French Republic entered the main hall of the Sorbonne to take part in the opening of the 'Congrès du Palais de la Découverte', many were struck by the civic simplicity of his appearance, contrasting strangely with that usually associated with assemblies in which the political heads of States take part. Even the accompanying sounds of the Marseillaise seemed merely to give an objective commentary on the political situation: 'Contre nous de la tyrannie l'étendard sanglant est levé. . . .' The opening speeches of the Minister of Education, and of Jean Perrin, who acted as president of the Congress, echoed this anxiety. Both speakers affirmed their belief that the independent search for truth embodied in science is the best safeguard of civilization against threatening destruction. Jean Perrin went to the length of acclaiming science as the new supreme religion destined to reign over the happy future.

At the first moment these utterances appeared strange and exaggerated, yet as the meeting went on, bringing out one symptom after another of the world-wide struggle of international science with various local tyrannies, they gained a very simple significance.

The political situation of science unfolded itself as the various delegates rose to greet the Congress. When, after the English and the Americans, the Germans got up they were listened to with the consideration due to the hardy survivors from a great flood. Later in the evening, in conversation with one of the German delegates, he spoke to me about a better understanding between the German and French peoples; and three delegates used what seemed to me to be the same official phrase. The Italian delegates did not mention politics. The U.S.S.R. was not represented by a single member. Great applause went up when the delegate of 'the Spanish Government' was called. He said little, but the words 'in the name of the Academy of Madrid' made all the subdued terror of the situation flare up in a momentary blaze. The Portuguese who followed him, the Jew who spoke later for the University of Jerusalem, evoked in turn their particular fringe of political associations, and so did the fact that no Japanese delegate appeared. By the time the list had finished the political scene of the world was fully illuminated, and on it the new situation of science was well visible.

Science, and generally the independent search of truth, is destroyed when political liberty falls. The totalitarian States which claim to be supreme spiritual beings can admit no independent thought, be it religious, political or scientific. By its very nature such thought must claim superiority to temporal power and is therefore incompatible with totalitarianism. Thus it is quite logical that in such States the position assigned to science by the official philosophies of dialectic materialism and racialism respectively should be merely to serve the higher aims of the State.

In view of this common fate shared by independent science and political liberty, the opening speeches of the Congress appeared in a clearer light. Their appeal to science from the depth of political anxiety was guided by the recognition that the link between science and liberty is completely reciprocal: while the profession of truth needs for its protection the free institution of democracy, these institutions themselves must decay and fall if people abandon their belief in reason. The idea of liberty derives its strength from many roots but among these there is one most vital: the belief that men can reach a better understanding by free discussion, that in fact society can be continuously improved if public life is steadily guided by reasoned controversy. It was a controversy on the question of a single fact from which about half a century ago the present political system of France emerged. A handful of men had faced the violence of the Government and the fury of the populace to establish the innocence of Dreyfus. They won, and modern political France was built on their victory. To-day the rise of a new threat to liberty causes the French Government to appeal with anxious hope to the men whose profession embodies the right to reasoned controversy and whose political duty is to defend this right. M. POLANYI.

PHYSICS

THIS international congress of physicists, chemists and biologists was conceived and organized within ninety days, chiefly through the initiative of M. Frederic Joliot-Curie, who was the chairman of the executive committee. It was attended by eleven hundred men of science

and four hundred other members. Its aims included the intellectual celebration of the success of the Palais de la Découverte, the unique quality of which was described in *NATURE* of August 21, p. 328, and which was visited by two million persons between May 25 and October 7.

The chief motive of the congress, which gave it exceptional vitality, was the concern of many of the leading men of science in France to struggle for the preservation and extension of the conditions upon which culture, science and democracy are equally dependent. M. Jean Perrin, M. Paul Langevin, M. F. Joliot-Curie and their colleagues are determined to act in support of these principles, which they regard as sacred. M. F. Joliot-Curie told me that good scientific workers would not willingly spare time from the fascinations of research, but to-day it was their duty to appeal to the people.

The scientific meetings were arranged in thirty-seven sections. It was characteristic of the anti-nationalistic spirit that no opening paper was given by a Frenchman. All the first speakers were non-Frenchmen of international standing. Prof. P. Scherrer (Zurich) gave a review of the results published on the nuclear reaction $D + D = {}^3\text{He} + n$. Various experimenters find that the number of deuterons needed to produce one neutron varies by a factor of 1,000, according to the compound of deuterium bombarded. Scherrer has bombarded heavy orthophosphoric acid with a beam of deuterons of 80 microamperes and 130 kv. The number of neutrons and their energy were measured from recoil atoms of helium with an oscillograph in an ionization chamber. For a pure D target and 100 kv. it is calculated that 8.9×10^6 deuterons produce one neutron. The energy of the nuclear reaction is 2.92 ± 0.3 Mev., corresponding to a mass for the neutron of 1.0090.

Dr. J. D. Cockcroft described the new high-tension equipment at the Cavendish Laboratory. This is housed in a hall of dimensions 25 m. \times 13 m. \times 14 m. A 1.2 Mv. generator of the multiplied voltage type has been installed, and another of the same type giving a continuous 2 Mv. is being installed. A 12 Mv. cyclotron is also being constructed. He discussed the transmutation of boron with fast protons. The experiments show that it breaks into three alpha particles in two steps. The first involves the formation of a nucleus excited to the very high level of 3 Mv. He discussed the physical significance of the separate existence of such an excited nucleus.

Prof. Niels Bohr (Copenhagen) described the essential differences between the dynamics of the nucleus and that of whole atoms. In the latter the movements of the constituent particles can be treated to a high degree of accuracy as those

of free particles in isolation. This leads to a great simplification, and a complete explanation of the details of the periodic table of the elements. In the nucleus the conditions are different. Here the constituent particles are very closely packed, and therefore under the mutual influence of forces which act only at very small distances. They act, therefore, as a collective system, and the energy of the nucleus is to be conceived as shared among the constituent particles. Disintegration occurs when sufficient energy becomes concentrated through mutual interactions on one particle. The final result of the nuclear reaction is determined by a concurrence between the various possibilities of disintegration and of the radiation of the collective system. From this point of view, the capture and expulsion of swift particles has analogies with the phenomenon of evaporation of a molecule from a liquid surface. One arrives at a notion of the 'temperature' of the collective system, which determines the speed of the ejected particles. In the case where the ejected particles are charged, the influence of the electrostatic forces is predominant, but with neutrons these forces do not exist. The collisions of slow neutrons exhibit resonance phenomena analogous with optical dispersion. Considerable progress has been made with the help of the theory of the collective system towards the understanding of the new data revealed by nuclear transmutations. Bohr remarked that very surprising analogies between the structure of nuclei and of organic molecules might be discovered.

Prof. P. M. S. Blackett (London) gave a thorough analysis of present knowledge of cosmic ray particles. The absorption of the soft component of energy up to 250 Mv. obeys the quantum theory, and the theory of Bhabha and Heitler explains the formation of cascade showers in thick plates. The evidence that the soft rays are Dirac electrons is satisfactory. But what are the hard rays? They penetrate a mile of water and produce their own type of showers. Examination of 5,000 tracks shows that only 20 exhibited abnormal ionization. All the heavy particles appear to be protonic, and Anderson's suggestion of the existence of a heavy electron seems to be rather too simple to explain the experimental evidence. Blackett suggests that, if the hard cosmic rays consist of heavy electrons, then it follows that they must have a variable rest-mass which is a function of their energy, and must change into ordinary electrons below energies of 250 Mv. But other explanations are possible.

Dr. J. Clay (Amsterdam) discussed the penetration of matter by cosmic rays and gave evidence for the existence of artificial radioactivity produced by cosmic rays. He finds that if a chamber

is suddenly covered with lead, the intensity of the cosmic rays passing through the chamber does not fall to a new steady value suddenly. There is a period of gradual decline which suggests the presence of artificially radioactive atoms with half-lives of eight minutes. He has observed similar effects when the lead is removed.

Prof. G. Lemaitre (Louvain) gave an account of his analysis of the deflection of cosmic rays by the earth's magnetic field according to Størmer's theory. The equations were developed in a form of Fourier series, and solved with the Bush machine at the Massachusetts Institute of Technology. The principal cone has been exactly determined up to latitude 30° , and the Johnson latitude effect has been satisfactorily explained.

Dr. W. Bothe (Heidelberg) discussed the different methods of the experimental determination of nuclear levels, depending on the spectra of gamma rays and ejected particles. He gave some new data concerning isomeric nuclei, and results of proton and neutron capture which may be interpreted by Bohr's new theory.

Dr. P. Debye (Berlin) gave a lucid exposition of the adiabatic demagnetization method of reaching very low temperatures. He remarked that the method is an excellent demonstration of Boltzmann's principle, because the application of a magnetic field has the effect of increasing the amount of atomic order, which is conserved during demagnetization, so the effect is equivalent to a cooling. Simon's recent experiments show that heat anomalies occur in two regions under the adiabatic process. In the second, at very low temperatures, ferromagnetic properties appear. He explained that the atomic theory of paramagnetism accounts for the experimental data, and also the considerable effect of relatively weak magnetic fields on calorific properties. He extended the notion into the domain of nuclear magnetism, and said that the calculations of Heitler and Teller on the time necessary to produce thermal equilibrium deserve very close attention.

Prof. E. Wiersma (Delft) discussed the recent progress in low temperature research, and Prof. F. Simon (Oxford) reviewed the recent experimental work. He referred to the impossibility of reaching absolute zero, and described the progress in the technique of liquefying helium. He said that Talmud in Leningrad has successfully used the 'bellows' method of liquefying helium which he had proposed ten years ago. Prof. M. Polanyi (Manchester) summarized the Griffith, Taylor, and other theories on the deformation of solid bodies. J. D. Bernal contributed to the discussion with an account of Stepanov's thermal theory of deformation.

Sir C. V. Raman spoke on the optics of colloids, and on ultrasonics in liquids. He described the

importance of the optical study of colloids for the determination of the size, form and distribution of the particles, and the analogy between the Tyndall effect and the diffusion of light by molecules. His general lecture on ultra-sonics was illustrated by striking metaphors. He described the experiment of Debye and Sears, and Biquard and Lucas, in which fringes are produced by light passing through a liquid transmitting ultra-sonic waves, as making sound visible, and as introducing the accuracy of optical technique into experiments on sound.

Dr. B. Van der Pol (Eindhoven) gave a lecture with experimental demonstrations of non-linear vibrations, and explained their importance in mechanics, electrical engineering and biology.

Prof. W. L. Bragg (Teddington) spoke on the structure and classification of silicates; Dr. U. R. Evans (Cambridge) on the state of the surface of bodies during corrosion; and Dr. F. London (Paris) on supraconductivity in aromatic compounds.

J. G. CROWTHER.

BIOLOGY

THE Palais de la Découverte, which represents a great effort of popularization on the part of French science, is an attempt, and a very successful attempt, to parallel the South Kensington Science Museum and the Deutsches Museum. In the biological section, for example, there are exhibits of evolution phenomena, embryology, tissue-culture, etc., and continuous demonstrations of such experiments as the Berger rhythm. All the most modern devices such as neon lighting and automatic switching are used to give life to the exhibits and diagrams.

On Friday, October 1, there was no specifically biological meeting, but many biologists took advantage of an elegant description of the polyterpene compounds by Prof. Ruzicka (Basel), who did not fail to point out the biological importance of the sterols and lipochromes while tracing the chemical similarities between them, and their transformations. The following day was entirely devoted to embryology. Prof. Holtfreter (Munich) gave a lucid address in which he went over the fundamental discoveries on which our knowledge of the material interactions of the parts of the embryo during its development is based. He described recent results obtained by his method of explantation of parts of amphibian embryos; thus a piece of the dorsal surface is taken from the neurula and cultivated in isolation: if from the spinal region, a neural ball is formed, surrounded by ectoderm; if from the eye-region, an eye-cup covered with ectoderm is formed, to which a naked piece of brain is attached. Such experiments are

of great value in analysing the process of induction, a question which C. H. Waddington (Cambridge) dealt with in the succeeding paper. Waddington also described the progress made with synthetic substances in Cambridge; thus œstrin itself, styryl blue, the acenaphthene derivatives, and to a lesser extent, squalene, can act as efficient evocators, inducing the appearance of neural tubes from ventral ectoderm.

In the afternoon Dr. J. Needham (Cambridge) spoke on carbohydrate metabolism and the morphogenetic process. The association, he said, between carbohydrate catabolism and the earliest stages of development, in which determinative processes are going on, has been observed by many independent investigators for many animal groups. The glycolysis of embryonic tissues appears to differ from that of adults, in particular the machinery of the phosphorylation cycles is not fully laid down at early stages, and non-phosphorylated glucolysis takes place. Organizer phenomena and carbohydrate metabolism are probably connected, since there are strong reasons for thinking that the evocator exists in its masked form in combination with polysaccharide and protein.

Monday, October 4, opened with a paper by Prof. D. Keilin (Cambridge), who dealt with the enzymes peroxidase and catalase which have protohæmatin compounds as their prosthetic groups. The reaction of these with their substrates changes the absorption spectrum and this allows the analysis of the mechanism of the reaction. Prof. R. Kuhn (Heidelberg), on the other hand, in dealing with vitamins, emphasized how in several cases they, or compounds very similar to them, may be united in combination with proteins, giving compounds of quite different properties. Thus the lipochrome retinene, almost identical with vitamin A, forms with protein the visual purple of the retina. Lactoflavin, vitamin B₂, forms with protein the dehydrogenating enzyme, flavoprotein, of Warburg; while vitamin B₁, a thiazol derivative, is one of the components of co-carboxylase. Phosphorylation may be as important as combination with protein.

In the afternoon Prof. J. H. Northrop (Princeton) described the present state of the work on the constitution of the crystalline enzymes, trypsin and pepsin. In none of these can any prosthetic group be detected, and practically any modification of the molecule leads to a loss of its enzyme properties. No fragments are active. Work on the bacteriophage was described and an analogy sustained between its power of increase and the autocatalytic action of trypsin on trypsinogen. He was followed by Prof. Warburg (Berlin), who in a brilliant address proposed a new classification

of active proteins (alloxazino-proteins, pyridino-proteins, ferro-proteins, etc.) according to the reactive groups.

On Wednesday, October 6, Dr. N. W. Pirie and J. D. Bernal (Cambridge) gave an account of their work on the plant virus of tobacco mosaic disease, from which this appears to be a nucleoprotein of special character, spontaneously forming liquid crystals of gigantic cell-size when isolated, but probably existing as spheres or short rodlike particles in the actual plant sap. This gave rise to a long discussion. Later Prof. Rideal (Cambridge) described the work of his collaborators and himself on monomolecular films of proteins and other substances of biological importance. Of particular interest was his demonstration that a sterol-protein complex, requiring long treatment with ether for separation, dissociates and reforms again under the pressures applied to it in monolayers.

Thursday, October 7, was devoted entirely to genetics. Prof. Muller (Moscow) gave a fine paper on the effects of radiations on the genotype, and this was remarkably extended by the lecture of Dr. Timofeev-Ressovsky (Berlin) in the same afternoon, who has succeeded in analysing the physico-chemical mechanism of X-ray-induced mutations much further than possible hitherto. Spontaneous mutations may now be regarded as mono-molecular reactions produced by thermal agitation when this oversteps the energy threshold of the chemical bonds. Mutations should therefore conform to the rules of chemical kinetics, and it has indeed long been known that, other things being equal, the mutation-rate is proportional to the external temperature. Prof. Haldane (London) gave an interesting discussion of the genetics of populations, introducing the term "cryptopolymorph" for populations such as man, many individuals in which carry recessive genes giving (sometimes deleterious) abnormalities. Finally, Dr. Wrinch (Oxford) developed her theory of protein structure, which she applied particularly to the structure of genes and chromosomes.

To one participant, at any rate, it seemed that the main idea which, in a quite unrehearsed way, ran through all the papers, was the great importance of compounds combined with proteins, either as loose complexes or as prosthetic groups. There were the lipochrome-protein compounds (Ruzicka, Kuhn), the sterol-protein compounds (Needham, Rideal), the vitamin-protein compounds (Kuhn, Warburg), the hæmatin-protein compounds (Keilin), and last but not least the nuclein-protein compounds (Pirie, Bernal and all the geneticists). It is the intention of the organizers of the congress to publish three volumes containing the contributions (Hermann et Cie., Paris), so that these will happily be available in permanent form. J. N.

BIOLOGICAL CHEMISTRY

THE rapid increase, during recent years, of our knowledge of the chemistry of the biological catalysts and of the chemical changes involved during intracellular respiration was the most striking feature of the Section of Biological Chemistry.

On the basis of this knowledge Prof. O. H. Warburg (Berlin-Dahlem) proposed a classification of these catalysts according to chemical structure. These ferments, or active proteins, he classifies into four groups.

Protein	Prosthetic Group	Active Group
1. Alloxazino protein	Alloxazine nucleotide	Alloxazine
2. Pyridino protein	Pyridine nucleotide	Pyridine
3. Cupro protein	Unknown	Copper
4. Ferro protein	Ferroporphyrin	Iron

As examples were quoted (1) the yellow enzyme, (2) the enzymes of alcoholic fermentation and hexose phosphate oxidation, (3) the catechol-oxidase of potato recently investigated by F. Kubowitz, (4) the well-known catalysts of the haemoglobin type. Such a classification will naturally meet with criticism in Group 2, where the conception of enzyme plus coenzyme forming as rigid a compound as, for example, haemoglobin will not be generally accepted. The action of these ferments was described in the case of hexose phosphate oxidation involving the stoichiometric transfer of hydrogen to atmospheric oxygen via the alloxazine and pyridine nuclei.

Prof. R. Kuhn (Heidelberg) dealt with ferments of the first two classes in a paper illustrating the close relationship between vitamins and ferments. Thus, aneurine (B₁) when phosphorylated is the prosthetic group of carboxylase, lactoflavine (B₂) plays a similar part in the yellow enzyme, while ascorbic acid (C) without phosphorylation is the active grouping of esterase. Prof. D. Keilin (Cambridge) confined his address to ferments of the fourth class. The three compounds methaemoglobin, peroxidase and catalase were taken as well-established examples, and the remarkable similarities in the chemical and spectroscopic properties were emphasized. In particular, an account was given of the spectroscopic study of the reaction with hydrogen peroxide, by which it was established that the iron of catalase, but not of the other two, is reduced in reacting with hydrogen peroxide. Manometric evidence for this reduction was also brought forward.

The discussion which followed these two papers centred mainly round the role of the yellow enzyme. It was generally accepted that oxidation *in vivo* of the reduced yellow enzyme, which cannot take place at the oxygen tension in the tissue, must be brought about through the intermediate action of the cytochrome system according to the scheme previously proposed by H. Theorell.

In dealing with the chemical nature of pepsin, trypsin and bacteriophage, Prof. J. H. Northrop (Princeton) stressed the difficulties of obtaining reliable evidence as to the purity of so-called pure crystalline preparations. Apparently the most reliable criterion is the solubility test based on phase rule considerations. Thus only with a pure substance will the concentration of dissolved solids remain constant as further solid is added to a saturated solution. This method has established that many preparations formerly believed pure are mixtures. An active crystalline nucleoprotein has also been obtained from bacteriophage. These substances contain no prosthetic group, and the properties must be ascribed to characteristic molecular structure. Their formation from inactive precursors involves but a very slight chemical change, which is autocatalytic.

A general discussion, entitled "Enzymes, Chromosomes, Virus," was opened by Dr. N. W. Pirie (Cambridge), but was mainly restricted to the subject of virus. The chief problem here is the exact relationship between the crystalline preparations and the virus as it exists in the plant. Ultrafiltration of tobacco mosaic virus shows that particle size increases during purification and gives rise to anisotropy of flow. J. D. Bernal, reviewing his work on the optical properties of purified preparations and on X-ray diffraction measurements, produced evidence of a linear aggregation of virus particles during purification, and was able to deduce the dimensions and spacial configurations of these aggregates. The identical 'unit cell' dimensions of three tobacco viruses find a parallel in the serological tests of Prof. Garcia, whereby the tobacco and potato viruses fall into two groups of closely related individuals.

An address by Prof. E. K. Rideal on chemical reactions in monolayers indicated a new line of approach to the study of changes within the cell, where surface reactions predominate. The change of chemical activity with molecular orientation in a monolayer is well illustrated by the action of permanganate on a film of oleic acid. By compression of the film the molecules assume a perpendicular position, the double bonds are removed from the interface and the oxidation practically ceases. Similarly, the photochemical decomposition of stearyl anilide can be stopped by compressing a film so that the benzene nuclei, revolving until parallel with the incident light, no longer absorb in the ultra-violet region. Similar technique makes possible the study of the orientation of protein molecules, with results in agreement with Astbury's X-ray diffraction method, and the degradation of proteins with loss of chromophoric groups (tyrosine residues) and formation of melanine.

E. F. HARTREE.

Obituary Notices

Mr. Richard Inwards

SOMETIME near the beginning of the present century a distinguished Continental meteorologist remarked that in England meteorologists were long-lived. It was perhaps the example of the Meteorological Council of that time that was in the mind of the speaker. If the remark had been printed in time it might have been included in the well-known book on "Weather Lore" by Richard Inwards, who died on September 30, at the age of ninety-seven, after seventy-six years of fellowship of the Royal Astronomical Society and seventy-five of the Royal Meteorological Society, including therein a considerable period of 'occlusion' at his residence in Croft-down Road, Highgate, accentuated by failing eyesight.

Mr. Inwards was born at Houghton Regis, not far from Dunstable, on April 22, 1840, the son of Mr. Jabez Inwards, and was educated at Soulbury, about ten miles away. In some way not apparent in the available records his education led to mining as a professional career. His interest in science is obvious from the first. He joined the Royal Astronomical Society at the age of twenty-one and the Royal Meteorological Society at twenty-two, when the latter Society was closely associated with the Institution of Civil Engineers and held its meetings in their room. According to "Who's Who", he managed mines in Bolivia and in Spain, and he reported upon mining enterprises in Norway, Austria, South America, Mexico, Spain, Portugal and England. His recreations were mechanical and microscopical.

When Mr. Inwards joined the Royal Meteorological Society, founded in 1850, it was engaged in organizing and collecting weather observations from volunteer observers in England, represented from 1881 onwards by an annual volume of the "Meteorological Record", while the Scottish Society, with Sir Arthur Mitchell, T. Stevenson (of the Screen) and A. Buchan, were discharging similar duty for Scotland. G. J. Symons was developing the British Rainfall Organization, Kew Observatory was held by the British Association, and the Meteorological Department of the Board of Trade under FitzRoy was organizing, collecting and co-ordinating observations from the sea.

In 1900 the Society had ninety-three stations of the second or third order, and among the names of observers we find E. Mawley at Berkhamsted, Sir J. W. Moore at Dublin, E. Kitto at Falmouth, H. Mallish at Hodsock, Sir Lothian Bell at Rounton, J. Baxendell at Southport, R. Bentley at Slough, F. Campbell Bayard at Wallington. Inwards's name does not appear, though he had already "passed the chair" of the Society in 1894 and 1895, with addresses on "Weather Fallacies" and "Meteorological Observations". He had been on the Council since 1884 and was treasurer in 1900, when Theodore Williams had passed up to be president on the death of G. J. Symons. He was joint editor of the *Quarterly Journal*

for about twenty years and contributed three papers ("The Metric System in Meteorology", "On Some Phenomena of the Upper Air", and "Turner's Representations of Lightning"). He also wrote "On an Instrument for Drawing Parabolic Curves" (*Phil. Mag.*, 1892) and "The Temple of the Andes", 1884. In 1911 he edited the "Life and Work of W. F. Stanley", the instrument maker.

Inwards is specially remembered for his book on "Weather Lore" published first in 1889, with a third edition in 1898. So it would appear that while helping his colleagues to collect and arrange observations from British localities he was himself engaged in collecting notes about the weather and its ways from the literature of the ancients and the moderns, ranging from Hesiod and Theophrastus to *Notes and Queries*. It is a wonderful collection of the weather wisdom of more than two thousand years of common experience, 206 pages displaying perhaps three thousand spontaneous inferences.

In respect of its arrangement this book is perhaps typical of the meteorological practice of the time and has something to do with the final sentence of Mr. Inwards's introduction to "Weather Lore" that "meteorology itself especially as regards English weather is very far from having reached the phase of an exact science". In the "Meteorological Record," as elsewhere, we find separate columns for the several items observed, and the page is so brimful of observations that one is reminded of a supersaturated solution which will develop into beautiful crystals if only an efficient nucleus can be suggested. So in "Weather Lore" we find remarks about weather collected and arranged in groups related to times and seasons, sun, moon and stars, wind, clouds, mists, and so on, while those who were dealing with observations of instruments were formulating their theory round the idea of the cyclonic depression, as they do now on the idea of fronts. In "Weather Lore" the grouping under the chosen headings is rigorous, regardless of latitude or chronology (outside the limits of the solar year) and generally regardless of orographic features. The reader may be pardoned for wondering whether some day a meteorological Kepler may co-ordinate the facts which are disclosed and formulate the insight into Nature which they carry.

Prof. de Burgh Birch, C.B.

WE regret to record the death, which occurred on September 18 at the age of eighty-five years, of Prof. de Burgh Birch, emeritus professor of physiology in the University of Leeds. Prof. Birch, who was born on May 18, 1852, received his medical training at Bristol and graduated at Edinburgh.

After three years as assistant to the professor of the Institutes of Medicine at Edinburgh, Birch went in 1883 to Leeds as the first full-time professor in

the School of Medicine, which had just been amalgamated with the Yorkshire College of Science in order to become a constituent of the Victoria University and had received a nucleus of an endowment of a chair in memory of Lord Frederick Cavendish. There was practically no equipment and as little money, so for ten years, while sharing in the work of a scheme for building a new school, he set about the task of equipping the department with the practical assistance of a young mechanical engineer—Kershaw—who later made a name in the invention and manufacture of instruments for the film industry. When the new school was opened in 1893 it was extremely well equipped for practical courses, especially experimental physiology.

The necessities of the time seem to have diverted Birch's mind from inquiry into physiological problems, for which he had shown excellent promise in his work with Rutherford in Edinburgh. His attention was given to perfecting apparatus: unless perfect an instrument was no use; when perfect it ceased to have interest. His bent for organization and making the fullest use of slender funds was well shown in his military hobby. He raised a medical staff corps with such success that little improvement was required to make it a full unit in the Haldane scheme. He retired with the distinction of C.B. after serving as A.D.M.S. of the unit of his own creation. In 1915, although more than sixty years of age, he was invited to resume the rank, and he accompanied the division to France.

The same bent was marked in the organization and discipline of Birch's department and in his conduct of the affairs of the Faculty in the dean's chair, which he occupied in the first seven years of the century and again from 1913 until his retirement in 1917. In these periods he laid certain lines along which the post-War development of the school were facilitated. In these days of grants of a liberality entirely unknown in the Victorian period, this generation can scarcely understand the amount of labour and ingenuity exercised by men like Birch in laying the foundations of a department in the condition of *magna inopia omnium rerum*. Though unquoted in text-books, he is one of the corner stones of the Leeds Medical School.

Dr. W. N. Bond

It is with much regret that we record the death of Dr. W. N. Bond, lecturer in physics in the University of Reading, which occurred on August 25, following an operation, while on holiday at Minehead.

Wilfrid Noël Bond was born on December 27, 1897, and educated first at St. Albans School and afterwards at East London College and the Royal College of Science, whence he graduated with first-class honours in the University of London. After nearly two years' experience in industrial research in the engineering works of Messrs. Kent in Luton, he returned to academic research work, first under Prof. A. W. Porter at University College, London, and later at the Cavendish Laboratory, under Sir J. J. Thomson, where he took his Cambridge B.A. by

research. He was appointed lecturer in physics in the University of Reading in January 1921, a position which he continued to occupy with distinction until his death.

A kind, patient and conscientious teacher, Bond was also keenly interested in research and published numerous original papers. Readers of NATURE may recall his recent investigations into the most probable values of the universal constants, made in connexion with the theories of Sir Arthur Eddington. Bond's experimental work was mainly (though by no means exclusively) concerned with the flow of fluids, and the allied subjects of viscosity and surface tension. An experimenter of exceptional skill and ingenuity, his methods were distinguished by their elegance and simplicity. His research work showed a steady development in power and maturity, and his most recent publications on "The Viscosity of Air" and on the "Measurement of Surface Tension by the Moving Sheet Method" (a continuation of which was passing through the press at the time of his death) reveal his work at its best. In addition to his original papers, Bond published three books, "Numerical Examples in Physics", "An Introduction to Fluid Motion", and "Probability and Random Errors", all of which received very favourable notices.

Modest, friendly and sincere, Bond will be greatly missed, not only by his students and colleagues to whom at all times he gave unsparingly and unselfishly of his best, but also by a much wider circle of acquaintances and friends. He is survived by his father, and leaves a widow and three children.

We regret to announce the following deaths:

Sir John Dewrance, G.B.E., president of the Institution of Mechanical Engineers in 1923, on October 7, aged seventy-nine years.

Dr. Paul Emerson, senior soil scientist of the Soil Conservation Service of the U.S. Department of Agriculture, an authority on soil bacteria, on September 20, aged fifty years.

Mr. W. B. Ferguson, K.C., known for his researches in photography, on October 7, aged eighty-five years.

Mr. W. S. Gosset, head of the scientific staff of Arthur Guinness, Son and Co., Dublin, known for his contributions to statistics and economics over the pseudonym "Student", on October 16, aged sixty-one years.

Prof. L. M. Hoskins, emeritus professor of applied mathematics in Stanford University, on September 8, aged seventy-seven years.

Sir Ashley Mackintosh, emeritus professor of medicine in the University of Aberdeen, an authority on nervous diseases, on October 14, aged sixty-nine years.

Sir John Moore, president of the Royal Academy of Medicine in Ireland in 1918-21 and president of the Royal College of Physicians of Ireland in 1898-1900, author of "Meteorology: Practical and Applied", on October 13, aged ninety-one years.

Prof. F. Morley, emeritus professor of mathematics, in Johns Hopkins University, on October 17, aged seventy-seven years.

News and Views

Lord Rutherford, O.M., F.R.S.

It is with profound regret that we record the death at Cambridge, on Tuesday, October 19, at sixty-six years of age, following a serious abdominal operation, of Lord Rutherford, whose experimental researches and scientific genius form the main part of the impressive structure of modern physics. By his friendly nature, as well as his alert and brilliant mind, he won the affection and esteem of all with whom he came in contact, whether as students, research workers, or members of the numerous scientific councils, committees and other bodies on which he served. The outstanding characteristics of his life, work, and influence were described by Maurice, Duc de Broglie, in *NATURE* of May 7, 1932, when Lord Rutherford was added to our series of Scientific Worthies; and there would be little to add to that article if it were now published as an obituary notice. We prefer, however, to arrange for personal tributes after a great scientific investigator like Lord Rutherford has passed into silence but leaving his friends a memory which will be cherished by them all throughout life, and a record in the history of science which will never be forgotten.

Dr. C. C. Paterson, O.B.E.

DR. C. C. PATERSON is delivering the Guthrie Lecture of the Physical Society for this year at the Imperial College of Science and Technology, South Kensington, at 5.15 p.m. on October 22. The title of the lecture is "The Appraisal of Lighting". Dr. Paterson is the director of the Research Laboratories of the General Electric Company, Ltd., Wembley. He was for sixteen years a member of the staff of the National Physical Laboratory, Teddington, where he established and administered the Electrotechnics and Photometry Divisions of the Laboratory until 1918. He then accepted the task under Lord Hirst of initiating the G.E.C. Laboratories at Wembley. These have now grown so much in size and influence that they have a personnel of 500 and cover a floor area of about 170,000 sq. ft. Dr. Paterson's activities have not been confined to the Wembley Laboratories. He was president of the Institution of Electrical Engineers in the year of the Faraday celebrations (1931). He has been president of the International Illumination Commission, the Illuminating Engineering Society, and this year of the Institute of Physics; he is also a vice-president of the Royal Institution and of the Royal Society of Arts. He has been Faraday Lecturer of the Institution of Electrical Engineers and Huxley Lecturer of the University of Birmingham. Whilst Dr. Paterson's activities in engineering and science have covered a wide range, his chief personal contributions and scientific papers have been in the fields of light and lighting. He has recently had the honorary degree of doctor of science conferred on

him by the University of Birmingham "in recognition of his many contributions and services to electrical science".

Prof. J. H. Gaddum

PROF. J. H. GADDUM, professor of pharmacology at University College, London, has been appointed to the University chair of pharmacology tenable at the College of the Pharmaceutical Society of Great Britain and has also been appointed director of the Society's Pharmacological Laboratories. Prof. Gaddum was educated at Rugby and at Trinity College, Cambridge, and afterwards he studied medicine at University College Hospital in 1922-24. From that time onwards he has been in the forefront as an investigator of problems of biological standardization. In 1924 he was appointed to the Wellcome Physiological Research Laboratories and in 1927 became assistant to Sir Henry Dale at the National Institute for Medical Research. From January 1934 he was professor of pharmacology in Cairo, and in the summer of 1935 was appointed to the professorship of pharmacology at University College which he has just relinquished. Prof. Gaddum was a member of the sub-committees on the biological standards for digitalis, strophanthus and ergot for the British Pharmacopœia, 1932: he also served on the sub-committee dealing with the accuracy of biological assays for the 1936 Addendum to the Pharmacopœia. His published work includes contributions on the estimation of strophanthus, thyroid preparations and on the determination of the toxicity of neosarphenamine. His other work has been connected with the detection and isolation of substances occurring naturally in the body, such as the estimation of histamine in blood. He is secretary of the Physiological Society.

Moriz Kaposi (1837-1902)

PROF. MORIZ KAPOSI, one of the leading dermatologists of the nineteenth century, was born at Kaspovár, Hungary, on October 27, 1837. He studied medicine at Vienna, where he qualified in 1861, and then became assistant to the celebrated Prof. Hebra, whom he succeeded later in the chair of dermatology in the medical faculty of the University of Vienna. He was the first to describe several new skin diseases, such as multiple pigmented sarcoma of the skin (1872), xeroderma pigmentosum (1876), to which he has given his name, and lichen ruber moniliformis (1886). In addition to collaborating with Hebra in his work on diseases of the skin, which was translated into English in the *New Sydenham's Society's* publications (1886-80), he brought out an independent work on skin diseases which was translated into English and French, and a handbook on syphilis, as well as numerous articles in the *Archiv für Dermatologie und Syphilis* and the *Wiener medizinische*

Wochenchrift. His lectures, which attracted numerous specialists from both his own and foreign countries, were remarkable for their clearness and precision, and many of his pupils afterwards occupied chairs of dermatology in different countries. Throughout his life he upheld Hebra's teaching, including the erroneous doctrine of the identity of chicken-pox and small-pox, and of measles and German measles. He died on March 16, 1902, a few days after the celebration of the twenty-fifth anniversary of his appointment as professor.

Compton Manor Estate: Veterinary Field Station

THE recent announcement that the Agricultural Research Council has purchased from Mr. Alfred Barclay the Compton Manor Estate on the Berkshire Downs will be welcomed by farmers and others having an interest in the well-being of agriculture and particularly the livestock side of the industry. In addition to the purchase of the land, the Council has arranged to buy the well-known pedigree herds of Ayrshire, Friesian and Guernsey cattle and also the herd of Large White pigs. A field station is to be established at Compton Manor primarily for investigation of problems of animal health and disease. Farmers, veterinarians and all workers in any branch of animal husbandry or nutrition will agree that a development of this nature is long overdue. Material advance has been made in recent years in our knowledge of the breeding and feeding of farm livestock, and while admitting that important advances in the diagnosis, prevention and treatment of many diseases have been made, it is unfortunately only too true that there are still diseases, of wide incidence and causing enormous loss, of which very little is known in the way of treatment. Until these diseases can be controlled or cured, the potential gain which could be derived from the existing knowledge of nutrition and breeding is very seriously curtailed. The Council's announcement mentions two such diseases on which it is proposed work should commence immediately, namely, contagious abortion in cattle and fowl paralysis in poultry stocks. A bad attack of either may seriously interfere with progress which has been made over years of constructive breeding and successful feeding and management.

In the investigation of diseases, the initial work must be carried out in research laboratories and then on small animals, but a stage comes when the results must be tried out on farm animals and under normal farm conditions. Facilities for this field work, while not non-existent, have been extremely limited in the past, and the creation of a field station for this specific purpose will help to bridge this gap. The field station will allow methods of treatment or control apparently successful in the laboratory to be tried out under practical conditions before being passed on to the farmer or practising veterinary surgeon. Another object in the establishment of the station is that it will be able to supply to other research institutes, for experimental purposes, farm animals of known history and free from disease. This service will bridge another gap; and in addition

to increasing the opportunities for work at existing research institutes, it will help to maintain the desirable collaboration between those institutions and the new station. The Council states it does not wish to set up a self-contained research institute, and hopes that, in addition to other methods of collaboration, existing institutes will second members of their staff to work at Compton on some problem when it would appear that the station is the most suitable place for joint work. All agriculturists, whether farmers or research workers, will watch with great interest the development of this new station, and wish it success in the important work which it is undertaking.

German and British Lantern Slides

A CORRESPONDENT writes: "Those who, during recent years, have attended lectures on scientific subjects in Germany will have been favourably impressed by the well-made, dignified lantern slides which are used there. In many cases, the slides are made with different colours to indicate the various curves or other significant portions of diagrams. Sometimes they have coloured arrows pointing to special details. The lantern slides are generally produced to a standardized system, so that time and mental energy are saved in knowing where to look for the title, date of preparation and other significant features. This year it was noticed that some of these lantern slides were made by the Technisch-Wissenschaftliches Lehrmittelzentrale, Berlin N.W.7, Dorotheenstr.32. There would appear to be no organization in England corresponding to this technical science teaching equipment centre and it is probably true to say that lecturers in this country generally use lantern slides less satisfactory than those seen in Germany. It is suggested, therefore, that it would be to the benefit of technical education in England if encouragement could be given to the production of high-class lantern slides in this country, through the Board of Education, organizations of technical teachers and similar bodies. In this manner they would assist technical education both from the point of view of the lecturer and of the student."

Lectures and Demonstrations at the Zeiss Works

NINE hundred scientific workers, including no fewer than 160 non-Germans, attended the second Zeiss-Kurs in Jena last month. As apparently only three Englishmen were present, it would appear to be worth recording that many German firms sent several representatives to this three-day course of twelve lectures, at which more than two hundred instruments were set out, to be demonstrated by between fifty and sixty experts. On one evening during the course, a performance was given in the Zeiss Planetarium. The first day was devoted to microscopy and metallography, the lecturers being Prof. Hanemann (speed of alloy transformations); Prof. Pomp (causes of failure in the working of iron and steel); Dr. Scheil (theory of hardening steel) and Dr. Hansen (light metals and their uses). The second day's lectures dealt with spectro-analysis and photometry, the lecturers being Prof. Gerlach (progress in spectro-analytical methods); Dr. Ginsberg

(new photometrical methods in light metal analysis); Dr. Ramb (various spectro-analysis investigations for industrial laboratories) and Dr. Kaiser (contributions to the spectro-analysis of light metal alloys). The third day's work was on fine measuring, the lecturers being Prof. Kienzle (means of obtaining reliable dimensional data regarding machine components); Dipl.-Ing. Claassen (supervision of gear wheel manufacture); Dr. Berndt (testing of gear teeth) and Herr Nichterlein (modern developments in projection as a means of measuring).

Engineering and Transport

IN his presidential address to the Institute of Transport on October 11, Sir Alexander Gibb suggested that we are on the threshold of another great advance in methods of transport. He did not speak of the experiments that the great physicists of the world are carrying out in their laboratories; he confined himself to consideration of the most that engineers can offer, to improve transport with the knowledge and means they have at present. In constructing bridges, the record for length (4,200 feet) is held by the Golden Gate Bridge at San Francisco. He said that American engineers are confidently looking forward to building, within the next ten years, spans up to 10,000 feet long. With present materials and the development of wire cable construction, it is quite possible to expand this length to 18,000 feet; but before this limit is reached, the ratio of dead load to live load would be too great to make spans of this length economically justifiable. In air transport the speeds at which aeroplanes will regularly operate will before many years equal or exceed the highest speed records at the present time, and the distances over which they will operate will be greatly extended. Sir Alexander doubts, therefore, whether floating seadrome bases or mother seaplane ships will ever be necessary for great ocean crossings.

At the moment, road design is the most urgent of the problems of transport engineering. It is purely a matter of policy and economics whether Great Britain should endeavour to develop road systems like those in Germany. In Great Britain there are 41,000 miles of road subject to the 30 m.p.h. restriction; and more than half the Great North Road is only suitable for two-line traffic, although we have the greatest density of motor traffic on the roads of any country in the world. Germany recently in one year spent 25 million pounds on entirely new road construction, and in 1935 the United States spent about 130 million pounds. In Great Britain the building of a new road is a rare event. A complete programme of new trunk motor roads in Great Britain, connecting all the principal towns, might cost up to a thousand million pounds. A further attempt to solve the traffic problems of London in the way that New York is dealing with its difficulties, on the lines of the regional plan of 1929, with its forty years programme, involving about 1,700 miles of parkways, boulevards, etc., would cost more. It might even not be possible. Sir Alexander pointed out that

these are not exclusively engineering problems. They must be examined from the economic point of view before a decision can be reached.

The Hanseatic Scholarships

It is announced in *The Times* that a Hamburg merchant, who desires to remain anonymous, has created out of his private means a fund to provide in the first instance not fewer than four scholarships annually, each of the value of 3,000 Rm., for young British graduates who desire to study in Germany. These scholarships are to be known as the Hanseatic Scholarships. They will be tenable for one year, may be held in any subject, and will be open to all students of the universities of the British Empire, with a preference for students from Great Britain. The founder hopes that the Hanseatic Scholarships may help "to further closer relations and understanding between the German and British peoples and to promote a consciousness of European solidarity". The trust, of which the first patron is the German Ambassador at the Court of St. James's, will be assisted in the selection and guidance of the scholars by a German and a British committee. The British committee, as so far constituted, will consist of: Lord Lothian (chairman), Dr. W. G. S. Adams, Prof. E. D. Adrian, Dr. George Gordon, Sir Henry Tizard, and Prof. H. G. Fiedler (secretary), professor of German language and literature, University of Oxford, from whom further particulars may be obtained.

Association of British Chemical Manufacturers

TWENTY-ONE years of activity were reviewed by the chairman, Mr. Eben Wallace, at the annual general meeting, held on October 14, of the Association of British Chemical Manufacturers, which was formally incorporated on December 28, 1916. The initial membership was 110 firms, representing a capital of £39,000,000, whereas now, although the actual membership has not shown any great increase, the capital represented is more than £200,000,000. The Association's directory, "British Chemicals and their Manufacturers", was first published in 1919, and a new edition has since been issued every second year. 1920 saw the formation of the British Chemical Plant Manufacturers' Association, whilst in 1927 the Association's Works Technical Committee commenced its work on safety in the chemical industries. Other activities have been concerned with fiscal matters, with the setting up of standards, with the organization of exhibitions, with the incidence of legislation, and, generally, with the promotion of co-operation within and around the industry. The annual report refers to the Association's activities, during the year ended May 31 last, in relation to the new Factories Act and other legislation, to the work of the Import Duties Advisory Committee, to commercial treaties, to safety measures, to the fund which the chemical industry has established in support of chemical publications and library facilities, to transport, and to various other relevant matters. Dr. F. H. Carr was elected president of the Association, and Mr. E. V. Evans and Mr. R. Duncalfe respectively chairman and vice-chairman of the council.

Plant Hormone Investigations

A STUDY meeting on the subject of "Phytohormones" was held at the International Institute of Intellectual Co-operation on October 1 and 2. This meeting, which was organized by the International Institute of Intellectual Co-operation and the International Union of Biological Sciences, was the first of a series that will be held in the course of the coming months and which will discuss a variety of questions such as "The New Vitamins", "Nomenclature of Genetics", "The Double Electric Layer", etc., included in the plan of work of the International Council of Scientific Unions, which acts as a committee of scientific advisers to the Intellectual Co-operation Organization. The meeting was held under the chairmanship of Prof. P. Boysen Jensen and reports were discussed on various aspects of the study of phytohormones, prepared by the following: Prof. F. Kögl, Utrecht; Prof. Niels Nielsen; Prof. N. J. Koningsberger, Utrecht; Prof. G. S. Avery, Connecticut; Prof. R. Bouillenne, Liège; Prof. C. Zollikofer, Zurich; Prof. K. Dostal, Brno; and nomenclature of phytohormones, by Dr. Janot, Paris. The question of the nomenclature of phytohormones gave rise to an exhaustive discussion and positive results have been reached. The reports and the discussions to which they gave rise will be published under the auspices of the International Institute of Intellectual Co-operation and the International Union of Biological Sciences. This publication will be revised by Prof. Boysen Jensen before being issued. The second meeting of this character will be held at Copenhagen at the end of September 1939. Profs. Boysen Jensen, Laibach and Koningsberger have been invited to organize this meeting from the technical point of view, in collaboration with the International Union of Biological Sciences.

Archæological Investigations in Ireland

ARCHÆOLOGICAL excavations continue to be carried on with vigour in Ireland through the scheme for the relief of unemployment under the direction of the Office of Public Works and the National Museum. Among the more important of recent discoveries are the antiquities brought to light in the excavation of the large ring fort at Garranes, near Templetown, Co. Cork, which throw a valuable light on the industries and culture of the little-known period of the sixth century of our era. The excavations are being conducted by Prof. Sean P. O'Riordain, professor of archæology in University College, Cork. The site is identified with Rath Raithleann. The fort has triple ramparts, with an external diameter of about three hundred feet. The entrance proved on excavation, according to a report in *The Times* of October 18, to be of a complex character, with several gates, of which the fourth and last in the approach to the interior was formed by rows of posts, small tree trunks of six inches in diameter, set in two palisade trenches terminating the middle bank at each side of the opening.

In the inner bank of the fort under masses of stone, which had been used to strengthen it, was a deposit showing that here had been the workshop of the metal-workers, who had been under the patronage of the ruler. Clay crucibles were found here in greater number than had previously been found in the whole of Ireland. Some still contained the bronze they had been used to melt, while others, of a type previously known from Scotland, but not hitherto found in Ireland, had been used to melt enamel. A discovery of extreme interest consisted of pieces of *millefiori* glass, made by fusing different coloured pieces of glass together, which leave no room for doubt that the *millefiori* glass of Irish ornament was a native product. Another important discovery was a quantity of pottery fragments, of which some are Roman, while others are copies. Such pottery has hitherto been lacking from Irish fifth and sixth century sites.

The Battersea Power Station

THE annual report of the Electricity Commissioners (London: H.M. Stationery Office) giving the returns of fuel consumption and electric units generated in Great Britain shows that the total quantity of electricity generated during 1936 was 14 per cent more than during the preceding year. The annual fuel consumption was 1.57 lb. per electric unit distributed. The steam station with the highest thermal efficiency, 27.63 per cent, is Battersea (London Power Company) and the station with the highest load, 208,000 kilowatts, is Barking A (County of London). The London Power Co. is extending its station at a cost of £1,500,000. The work constitutes the beginning of the second half of the station and includes the extension of the building to double its present size and the installation of 100,000 kw. of generating plant. This is the first instalment of the plant to be provided in the new building. It is expected that this, together with the 243,000 kw. plant already working, will meet the probable demands for electricity up to the winter 1939-40. Eventually the generating capacity is to be raised to 500,000 kw. The new plant comprises a high-pressure set, a low-pressure set and a house set. The high-pressure set generates 16,000 kw., the low-pressure set 78,000 kw. and the house set 6,000 kw. The new plant also includes one boiler of 550,000 lb. evaporative capacity. Londoners will watch the development of this huge power station with interest. Practice has justified the policy of fostering the efficient stations in Great Britain. The returns show that whilst there were 458 generating stations in 1935, there were only 442 in 1936.

Loris: a Journal of Ceylon Wild Life

In many respects the fauna of Ceylon is of unusual interest, and like many another island fauna it runs the risk of gradual encroachments at the hands of 'civilized' man. In order to further the preservation of the native animals and to stimulate a greater interest in them and their habits, the Ceylon Game and Fauna Protection Society has undertaken the

publication of a new natural history magazine, *Loris*, to be issued twice a year (Colombo and London: *Times of Ceylon Co., Ltd.* 2s. 6d.). That there is need for such propaganda is shown by the history of faunal protection in Ceylon, which A. B. Lushington contributes to the first number. The slaughter of sambhur and deer for the sake of the export of their hides and horns had reached gigantic proportions and entailed great cruelty, before the Government in 1891 passed ordinances to check the trade and to "prevent the wanton destruction of elephants, buffaloes and other game". Even so the trade continued, and several subsequent enactments have been required to bring about the protection which was desired. The first number of *Loris* is by no means confined to direct propaganda, for the editors are aware that the stimulation of interest in animal life is a better means to their end than mere denunciation. Accordingly they include sporting articles of a naturalist flavour, accounts of trips in the jungle, and an instructive article on natural history photography and the apparatus it demands, illustrated by excellent photographs of birds and nests.

Fisheries of Wales

A TEMPORARY exhibition illustrating the activities of the Welsh fishing industry has been on view during the past five months at the National Museum of Wales. A small hand-book supplements the information given on the labels of the exhibits ("The Fisheries of Wales". By Colin Matheson. National Museum of Wales and the Press Board of the University of Wales. 2d.). The fishes landed in the largest quantities in Wales are demonstrated by models and spirit specimens, and the handbook sets forth the habitats and means of capture of the different species, with some comments on their biology. The hake, on which the deep-sea fisheries of South Wales are based, is given due prominence. A separate section is given to the deep-water trawler and its methods of work, with exhibits of echo-sounding devices and wireless direction-finders. The beam trawl and various appliances of the inshore fisherman are explained; and there are notes upon the primitive Welsh coracle and the salmon nets and spears used in fresh water. The general ignorance about the modern fishing industry is so great that a welcome must be extended to such an exhibition as this, for it will show that each species of fish must be sought by methods adapted to its habitat and habits; and that every fishing boat more than 20 feet long is not necessarily a trawler. Mr. Matheson is to be congratulated upon the arrangement of such a demonstration.

British Association Seismological Committee

THE recent report of the Committee of Seismological Investigations records much useful work done by its members. During the preceding year, three slight earthquakes occurred in the British Isles: in East Kent on December 29, 1936, in North Staffordshire on April 7, 1937, and near Inverness on June 28, 1937. Brief references are made to the study of the recent earthquakes in Montserrat, to Mr. Brennan's work

on the greater frequency of earthquakes in Jamaica during the dry months of the year, to the deep-focus earthquakes of 1932, and to the new globe, 18 in. in diameter, recently installed at Oxford, which has already proved most useful in the determination of epicentres. Notes are also contributed by Dr. H. Jeffreys on seismic transmission times, and by Dr. R. Stoneley on his study of the records of the Mongolian earthquake of August 10, 1931.

Parliamentary Science Committee

THE Right Hon. J. Ramsay MacDonald has recently accepted an invitation to join the executive of the Parliamentary Science Committee. It has always been the aim of the Committee to preserve an even balance between men of science and Parliamentarians on the executive, and on the Parliamentary side to secure representatives from all political parties. Mr. MacDonald's advent brings the Parliamentarians up to eleven—three peers, and eight members of the House of Commons. The three peers are the Earl of Dudley (president), Lord Melchett and Lord Rothschild. The members of the lower house are Sir Arnold Wilson (chairman), Mr. Alan Chorlton (deputy-chairman), Mr. Ramsay MacDonald, Prof. J. Graham Kerr, Sir Philip Dawson, Sir Murdoch MacDonald, Mr. Andrew MacLaren, and Mr. S. F. Markham.

Komodo 'Dragons' at Edinburgh Zoological Park

By permission of the Netherlands Government, two Komodo monitors (*Varanus komodoensis*) have been added to the collections at the Scottish National Zoological Park in Edinburgh. This gigantic lizard, which may reach a length of 10 feet, was first shown in Great Britain at the London Zoo in 1927, a year after the habits of the creature had been studied by an American expedition in its native island of Komodo to the south-east of Java. It is swift and active out of keeping with its heavy build, and is said to be fierce as well as voracious, the larger individuals feeding when opportunity offers upon deer and wild pigs.

The Joint Committee on Materials and Their Testing

THE Joint Committee, which consists of representatives of twenty-four co-operating technical institutions and societies under the chairmanship of Dr. H. J. Gough, has arranged its first technical discussion to take place in the College of Technology, Manchester, on October 29, commencing at 2.30 p.m., when a series of three important papers on different aspects of "Notched Bar Impact Testing" will be presented. Application forms for papers and reprints, and for tickets to attend, should be made to the Secretary, the Manchester Association of Engineers, St. John Street Chambers, Deansgate, Manchester, 3. Particulars regarding the objects, aims and work of the Joint Committee may be obtained from the Secretary, Joint Committee on Materials and their Testing, at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1.

Aeronautical Research in Australia

MR. H. E. WIMPERIS, who retired last March from the position of director of scientific research to the Air Ministry, is at present visiting Australia at the invitation of the Commonwealth Government. The determination to establish an aircraft industry in Melbourne has focused attention on the need for greatly improved facilities for scientific investigation, and Mr. Wimperis will advise the Government early next year on the steps which he considers necessary for the initiation and steady development of aeronautical research. A careful survey is being made of existing laboratories, particularly in the universities, to determine to what extent they may serve specific purposes in association with a central establishment.

Institution of Civil Engineers: Awards for Papers

THE following awards have recently been made for papers read and discussed at ordinary meetings of the Institution of Civil Engineers: Telford Gold Medal to D. M. Watson. James Watt Gold Medal to Sir Noel Ashbridge. Coopers Hill War Memorial Prize to J. Guthrie Brown. Telford Premiums to A. H. Naylor; Dr. S. F. Dorey; F. W. A. Handman; C. L. Howard Humphreys; G. E. Howorth; B. W. Huntsman; Dr. L. R. Wentholt; Prof. S. M. Dixon, Gerald FitzGibbon and Dr. M. A. Hogan; Prof. A. J. Sutton Pippard, Eric Tranter and Letitia Chitty; and A. J. Dean. Indian Premium to Dr. H. J. Nichols. Trevithick Premium to D. A. Stewart. For papers published in the *Journal* with written discussion the following awards have been made: Webb Prize to Dr. P. L. Henderson. Manby Premium to Prof. H. W. Swift. Crampton Prize to B. D. Richards. Telford Premiums to Dr. W. H. Glanville and F. G. Thomas; J. C. Richards; and Robert Ferguson. Trevithick Premiums to E. N. Webb and Prof. B. L. Goodlet. For students' papers read in London or at meetings of local associations the following awards have been made: James Forrest Medal and a Miller Prize to D. F. Orchard. Miller Prizes to S. K. Jordan; N. C. C. de Jong; D. M. Hamilton; R. C. Whitehead; Henry Grace; and F. C. Squire. The Baker Gold Medal for the triennial period 1934-37 has been awarded to B. M. Hellstrom and the Howard Quinquennial Prize for the quinquennial period 1932-37 has been awarded to Prof. J. F. Baker.

Announcements

SIR ROBERT ROBERTSON, treasurer of the Royal Institution, and lately Government chemist, has been appointed director of the Salters' Institute of Industrial Chemistry in succession to Prof. Arthur Smithells, who has resigned through ill-health.

THE Baly Medal of the Royal College of Physicians of London was presented on October 18 to Prof. E. L. Kennaway, professor of experimental pathology in the University of London and director of the Research Institute of the Royal Cancer Hospital, for his biochemical investigations which have led to the identification of a group of substances provoking malignant growth of tissues.

THE Planck Medal of the German Physical Society has been awarded to Dr. Erwin Schrödinger, professor of theoretical physics at Graz.

THE following awards have been made by the Institution of Naval Architects: Parsons scholarship in marine engineering (1937) to S. F. Rice of Messrs. G. and J. Weir, Cathcart, Glasgow; the scholarship is of the value of £150 per annum, and will be held at the Royal Technical College, Glasgow, for four years; Denny scholarships in naval architecture and marine engineering (1937): the naval architecture scholarship to A. Silberblatt, of Kilburn Grammar School, and the marine engineering scholarship to P. Martin, of Eltham College; both scholarships are of the value of £75 per annum and will be held at the University of Glasgow for four years.

THE Hillel pharmaceutical concern in Haifa, Palestine, has recently announced the foundation of a Hillel prize of 2,500 dollars for medical work in Palestine. Prof. Gottlieb of Vienna, the founder of the concern, has stated that funds had been provided by the company for raising the standards of hygiene in Jewish agricultural settlements in Palestine.

UNDER the auspices of the Food Education Society, Dr. M. Bircher-Brenner of Zurich will give three addresses on "The Principles of Therapy according to the Laws of Life" at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, on October 25, 27 and 29 at 8 p.m. Admission is free.

THE ninth International Ornithological Congress will be held at Rouen on May 9-13, 1938, under the presidency of Prof. A. Ghigi. Visits will be paid to Paris on May 14-15, and on May 16-19 there will be a long excursion to the Carmargue. Further information can be obtained from the Secretary, M. Jean Delacour, Chateau de Clères, Clères, Seine Inférieure, France.

WE have received a copy of an attractive publication entitled "The World from a Window Garden" compiled by Grace E. Pulling (Society for the Propagation of the Gospel in Foreign Parts, 15 Tufton Street, London, S.W.1. Pp. 88. 1s. 6d.). It takes the form of a diary for gardening or engagements, and contains notes on some plants suitable for cultivation in window-boxes, hanging baskets, etc. Apart from general descriptive notes and hints for culture, not the least interesting are brief references to the history and geographical distribution of each plant. The work is illustrated by forty photographs, twenty neat black-and-white drawings by Frank J. Stanley, and eight beautifully executed water-colour drawings by various artists.

ERRATUM. In the second part of the table included in the letter "Solubility of Silica Dusts" by Dr. E. J. King in *NATURE* of August 21, p. 320, for "acetic fluid" read "ascitic fluid".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 730.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Recent Improvements in Diffraction Gratings and Replicas

THE advent of the aluminized glass mirror has done away with many of the difficulties of making diffraction gratings of large size and unique properties. Some years ago, after some preliminary experiments in diamond grinding and adjusting, we ruled a six-inch three-metre concave grating with 15,000 lines to the inch which threw about 80 per cent of the light into one first-order spectrum. This estimate was made with a photo-electric cell and the light of a high-intensity mercury arc passed through a green filter.

Feeling that we had the problem solved, we sent this grating to Prof. Herzberg of the University of Darmstadt, but we have not been able to duplicate its properties, until we abandoned speculum for aluminium. The first large grating ruled on this metal was a plane one with a ruled area measuring about 4 in. \times 5.5 in., 15,000 lines to the inch, throwing perhaps 75 per cent into the first order for red light, and giving a very strong spectrum in the second order for the ultra-violet. This grating has been in continuous use on the spectrograph of the 100-inch telescope of the Mt. Wilson Observatory, and was responsible for the discovery of ionized titanium vapour in interstellar space. More recently, we have sent a still better grating to the Observatory ruled on an 8-inch disk of aluminized Pyrex glass which Dr. Adams reports as 30 per cent brighter than the first one. In a letter he tells me that, with the first grating which we sent, he believes that they have made the finest stellar spectrograms ever produced and that in his opinion the day of the glass prism for star spectrographs is over.

This high concentration of light in a single order cannot, however, be accomplished with a ruling of 30,000 lines to the inch, since the diffracting elements are now too narrow to act as oblique mirrors giving preferential direction to the diffracted energy. It is also difficult to produce such rulings on concave surfaces, especially those of short focus, owing to what I have called the target pattern, which shows up as concentric circular zones of different colours, especially at fairly large angles of incidence. These are due to the change of form of the groove, as the diamond drops down into the bowl, for as the diamond descends, the ruling edge turns through a small angle, coming up more on to its point. My assistant, Mr. Wilbur Perry, has developed a very ingenious method of compensating for this difficulty, and we have

already obtained promising results with it on some small gratings of 50 cm. radius.

Fig. 1 is from an enlargement of the green mercury line in the third order of the last 30,000 line grating ruled. This was a 6 in., 21-ft. grating ruled on aluminium, and the photograph was made with the slit and plate close together. The print shows clearly the several components of the line and the freedom from ghosts; there is also a lack of appreciable background, indicating that nearly all the reflexion is specular and not scattered. The exposure was only ten minutes.

I have been making a lot of replicas from the $4\frac{1}{2}$ in. \times 6 $\frac{1}{2}$ in. aluminium plane grating, which I estimate contain 80 per cent (concentration) for λ 4300 and 50 per cent for the extreme red. Combined with a flint prism of 25° it gives direct vision (normal) for the blue-green boundary, and the dispersions are added. I have just mounted one on the 6 in. 25° objective prism of the Lick Observatory. To obtain the same dispersion with prisms, several would be necessary, and the spectrum would be very far from normal.

By employing aluminium deposits of several times the thickness of those in common use, it is now possible to construct very superior echelette gratings for the infra-red. Gone are the old difficulties of producing optical flats of copper, free from embedded grains of abrasive which wore away the razor edge of the ground diamond. Replicas made from such echelettes by flowing them with a nitro-cellulose solution, stripping the film and mounting in optical contact with selected plate glass, or better still plane parallel glass, may give by transmission as much as 90 per cent of the light in the first-order spectrum, as I showed some years ago with replicas taken from a 15,000 ruling on commercial half-tone copper plate. Such replicas can be made with a ruled area measuring $4\frac{1}{2}$ in. \times 6 $\frac{1}{2}$ in. and with a 5-inch telescope show the D lines with a separation fully equal to eight times the width of the lines. One of these has been in use at the Harvard Observatory every clear night by Dr. Whipple during the past year as an objective grating for obtaining the distribution of the different gases in nebulae.

The introduction of the modern plastics, such as Lucite, makes it seem probable that fair gratings of small size, both plane and concave, may be made by a moulding process. The casting of a concave grating from a ruling made on a convex spherical surface has been in the minds of all interested in the cheap duplication of gratings for many years, but the few experiments which I made some years ago with Bakelite did not look promising as the casts warped. More recently I have obtained better results with Lucite, the castings being made with polymerized material, softened by a moderate temperature and

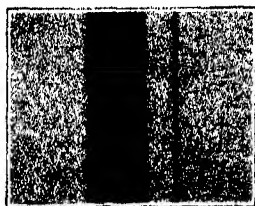


Fig. 1.

under high pressure. Whether the technique can be developed to such a point that a large casting can be separated from the metal surface without losing its figure remains to be seen. If this can be accomplished and the ruled surface is found to keep its structure intact during the ordeal of the bombardment by aluminium vapour, excellent concave gratings should be within the means of the smallest institution. This can doubtless be accomplished, as a nitro-cellulose replica from an echelette grating has been successfully coated with aluminium.

R. W. WOOD.

Lake Louise,
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July 15.

Coronal Emission Lines observed at the Total Solar Eclipse of June 19, 1936

At the total solar eclipse of June 19, 1936, a joint party composed of observers of the Tokyo Astronomical Observatory and the Central Meteorological Observatory of Japan, headed by me, was engaged in various sorts of observations of astrophysical as well as geophysical interest at Nissin ($\lambda = 9^h 37^m$, $\phi = 43^\circ 51'$) in Hokkaido.

An exposure of 50 seconds made by myself and Mr. Koiwai with a slit spectrograph with two 55° prisms of very heavy flint and a Tessar type camera lens of 55 mm. aperture having the focal ratio $f/45$ gave fourteen bright lines that cannot be attributed to chromospheric emission. Their wave-length calculated by referring to a number of well-situated Fraunhofer lines of the photospheric spectrum taken a few minutes before second contact are tabulated below. The accuracy for the lines near the red end and for those near the blue end is not satisfactory, for the instrument was focused for the green part and the curvature of the focal surface was not negligibly small.

No.	Wave-length	Intensity	No.	Wave-length	Intensity
1	4312	1*	8	5738.0	1
2	4725.3	1	9	5930.3	2
3	4815.9	1	10	6266.9	1
4	5116.4	2*	11	6373.9	6*
5	5302.8	>4*	12	6534	2
6	5624.4	1	13	6703	2*
7	5718	1	14	6777	1*

The lines marked with an asterisk are of recognized coronal origin. Beside the above lines there appeared chromospheric lines such as $H\alpha$, $H\beta$, $H\gamma$, D_2 , 4472 He, etc. But out of another 20 chromospheric lines within our region of intensity exceeding 20 (Mitchell's values¹), we could detect with confidence only five on our plate, and none out of 140 chromospheric lines of intensity between 8 and 20. This fact must be borne in mind in considering the significance of the lines in the above table. There are no chromospheric lines near them the intensity of which exceeds 7 on Mitchell's scale.

Some of the outstanding features of the spectrogram are mentioned below:

- (1) Predominance of the green line $\lambda 5303$.
- (2) So far as the region near the eastern limb is concerned, the coronal emission in lower latitudes, especially over the spot zones, appeared to be more intense and to have extended to a higher level than in the polar region.
- (3) The fact observed by me that the line $\lambda 6374$, though inferior in intensity, extended farther outward

than $\lambda 5303$ seems to give support to the view of Prof. Mitchell² that they can be classed in separate groups.

(4) The fact that the line 4725.3, which has been rejected by Prof. Stratton³ and others from the list of coronal lines, appeared on our plate, points to the necessity of reconsidering the possibility of its being a genuine member of the coronal emission spectrum. In this connexion, it may be cited here that Prof. Tanaka of the Tokyo Imperial University has also pointed out its reality on his spectrogram taken at the same eclipse by means of a three-prism apparatus, giving the wave-length 4725.4 by comparison with the iron arc lines⁴. Special attention must be paid to the fair coincidence of the wave-length of this line with that of the nebular line $\lambda 4725.7$. The lines 4815.9 and 5738.0 also respectively come close to the nebular lines $\lambda 4814.78$ and $\lambda 5737$ observed in the spectrum of η Carinae by Moore and Sanford and also by Lunt⁵.

On each of three plates taken by means of another spectrograph with four prisms (60° , 60° , 45° and Rutherford's compound system), which was used without slit, a few monochromatic rings of coronal emission could be detected. We can easily perceive on one of these the difference in the general mode of intensity distribution of the lines $\lambda 5303$, 6374 and 6704; thus those lines seem to originate from different kinds of atoms or at least from atoms in different states of excitation. On the same plate there is a short emission arc detected near $H\alpha$. It is rather weak but distinct. Its reality cannot be doubted as judged by its general appearance and by the fact that the curvature is quite consistent with that of $H\alpha$. Moreover, it shows a rather sharp boundary on the concave side, namely, towards $H\alpha$, fading gradually toward the convex side, even manifesting some sort of structure. This arc is limited to the range of position angle a little less than 30° in middle latitude along the north-eastern quadrant of the sun's limb. It may be remarked that this is the region which corresponded to the most active zone of the solar surface at that time, as shown by independent photographs and spectroheliograms. Such a peculiar distribution of emission intensity is quite contrary to that of the other three emission lines, which were observed to extend over other quadrants with remarkable intensity, and lends support to the view that this line belongs to a separate group of atoms.

It is a remarkable fact that the wave-length of the above line calculated by referring to $H\alpha$, $\lambda 6703.5$, $\lambda 6374.2$ and assuming the effective lower boundary of each coronal emission layer to be located at the upper limit of the $H\alpha$ chromosphere, came out to be 6583.8, which nearly coincides with $\lambda 6583.6$, the well-known nebular line⁶ as given by Wright. Moreover, there was detected another faint arc, barely visible near $H\alpha$ on its violet side and over nearly the same range of position angle as $\lambda 6583.6$. The wave-length computed in the same manner as 6584 is 6548.7. This result is also noteworthy since it comes very near the nebular line $\lambda 6548.1$, though the real existence of this arc cannot be regarded as so conclusive as $\lambda 6584$. This, with the former line, was observed⁶ in the spectrum of the Wolf-Rayet star D.M. + $30^\circ 3639$.

Finally, it is to be remarked that our detection of such weak lines by a prismatic camera owes its success to their chancing to be placed in a part of the spectrum where the photographic density due to

the continuous spectrum was extremely feeble, so as to bring out sufficient contrast of the line against the background; and also to the excellent focusing of the apparatus, which had been attained by using a long and slender neon discharge tube of circular shape with a considerable diameter set at a distance of about 200 metres for focus adjustment and also for rehearsing.

A full account of the work will be given in a paper which is now in preparation to be published shortly.

RIKITI SEKIGUTI.

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Aug. 23.

¹ *Astrophys. J.*, **71**, 1 (1930).

² *Astrophys. J.*, **75**, 1 (1931).

³ *Mem. Roy. Ast. Soc.*, **64**, 105 (1927).

⁴ *Proc. Phys. Math. Soc. Jap.*, (iii) **19**, 693 (1937).

⁵ Wright, W. H., *Lick Obs. Publ.*, **13**, Part vi (1918).

⁶ Baxandall, F. E., *Mon. Not. Roy. Ast. Soc.*, **79**, 619 (1919); Lunt, J., *Mon. Not. Roy. Ast. Soc.*, **79**, 628 (1919).

⁷ Wright, W. H., *Lick Obs. Publ.*, **13**, Part vi (1918).

⁸ Wright, W. H., *Lick Obs. Publ.*, **13**, Part v (1918); Merrill, W., *Lick Obs. Bull.*, **7**, 129 (1913).

THE unusual brightness of the corona at the 1936 total eclipse—it was easily seen several seconds before totality began—has given Prof. Sekiguti and his colleagues the chance of obtaining some new lines in the emission spectrum of the corona. Confirming Prof. Tanaka, he restores the line at 4725 Å., previously rejected as being insufficiently supported, to the list, and points out that this line and several other lines are close to, if not identical with, certain lines in the spectra of nebulae and novae. His new spectral lines strengthen the link between the coronal and nova spectra based previously solely on the presence of the stronger coronal lines in the spectrum of RS Ophiuchi a few weeks after its outburst in 1933.

If Prof. Sekiguti's identification of the two weak arcs in the objective prism spectrograms is accepted, then we have evidence for the first time of a known element in the corona, namely, nitrogen, for the lines 6548, 6584, which Prof. Sekiguti classes together, are forbidden lines in the spectrum of N II. New emission lines in the spectrum of the corona have been reported as secured by Dr. Dunham at the eclipse of last June. Their wave-lengths will be awaited with interest. Before long the last important celestial spectrum of unknown origin may have been identified.

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Phosphorus Exchange in Yeast

THE individual phosphorus atoms present in the leaves of plants have been found¹ for the most part to exchange with great ease within a short time. We extended our experiments to the behaviour of phosphorus atoms present in yeast.

Yeast was grown in a culture solution which, after the lapse of some days, was replaced by a similar solution containing 8.7 mgm. of labelled phosphorus per 100 c.c., besides the usual amount of salts and in some cases ten per cent sugar, in others none. The radioactivity of the labelled sodium phosphate was such that 1 mgm. P corresponded to 1000 activity units. After the yeast had grown for twenty-four hours in the solution containing labelled phosphorus, it was removed, washed carefully and digested by treatment with sulphuric acid and nitric acid. The phosphorus content of the solution of the

yeast was determined both by radioactive measurements and by the usual chemical (colorimetric) analysis.

The results of both determinations for the last set of a long series of experiments are given in the accompanying table. As seen from the later the same figure for the uptake of phosphorus was obtained by the chemical and by the radioactive analysis. We can conclude from this coincidence that no exchange of phosphorus atoms takes place between the yeast and the culture solution. Had such an exchange taken place we would have higher values by the radioactive than by the chemical analysis.

The lack of exchangeability of the phosphorus atoms present in yeast could be interpreted on the assumption that yeast contains little or no readily exchangeable phosphate ions but only phosphorus compounds like hexosephosphates, adenyphosphoric acid and so on in which the phosphorus atoms are not or are only slowly exchangeable with the inorganic phosphate ions.

An alternative explanation would be that yeast cells are impermeable to phosphate ions except when growing.

Yeast grown	Dry weight of yeast (mgm.)	Total P found by chemical analysis (mgm.)	Total P per mgm. dry weight of yeast	Mgm. P taken up	
				chem. analysis	radio-active analysis
Initial weight and P content of yeast samples used	108.6 108.0 108.4	1.375 1.384 1.361	0.0127 0.0128 0.0126		
In labelled P with sugar at 25°	249.8 260.2 252.3	3.414 3.407 3.390	0.0137 0.0131 0.0134	2.046 2.034 2.017	1.966 1.987 2.095
In labelled P with sugar at 0°	101.4 103.1 101.5	1.295 1.309 1.320	0.0128 0.0127 0.0130		0.004 0.012 0.012
In labelled P without sugar at 20°	89.2 88.1	1.369 1.345	0.0153 0.0153		0.044 0.054

The radium-beryllium mixture was most kindly put to our disposal by Prof. Niels Bohr; we should also like to express our thanks to Mr. V. Hartelius, Mr. H. Lantz and Miss Hilde Levi for their assistance in this work.

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¹ *NATURE*, **127**, 66 (1936); **129**, 149 (1937).

Glycerophosphoric Dehydrogenase

THE question whether the dehydrogenation of α -glycerophosphoric acid by animal tissues depends upon the catalytic action of coenzyme I (diphosphopyridine-nucleotide) has recently been the subject of controversy¹⁻⁴. The extraction of a very powerful α -glycerophosphoric dehydrogenase preparation from horse brain by a modification of Green's method¹ has offered an opportunity of contributing a few observations.

The enzyme is prepared in the following way: minced horse brain is incubated with two volumes of M/20 bicarbonate at 37.5° for 20 minutes. The extract is centrifuged off, care being taken that only the red supernatant layer is decanted, and the

residue washed twice with two volumes of water. The combined extract and washings are brought to pH 4.6 by addition of dilute acetic acid, centrifuged, the precipitate washed twice with distilled water and resuspended in two volumes of *M*/15 veronal buffer, pH 8.2.

Pyocyanine was found to be more active as 'carrier' with this enzyme than either methylene blue or brilliant cresyl blue (Table 1).

TABLE 1.

2 ml. enzyme, 0.3 ml. <i>M</i> /2 dl-Na- α -glycerophosphate. Values corrected for blanks.			
	0.5 ml. <i>M</i> /50 methylene blue	0.5 ml. <i>M</i> /50 brilliant cresyl blue	0.5 ml. <i>M</i> /50 pyocyanine
Oxygen uptake in 10 min. (μ l.)	132	134	216

Although the enzyme preparation contained no coenzyme I, its addition did not influence the oxygen uptake at all. This result corroborates the observations of Green¹ and of Dewan and Green². To explain the divergent results of the Stockholm workers who

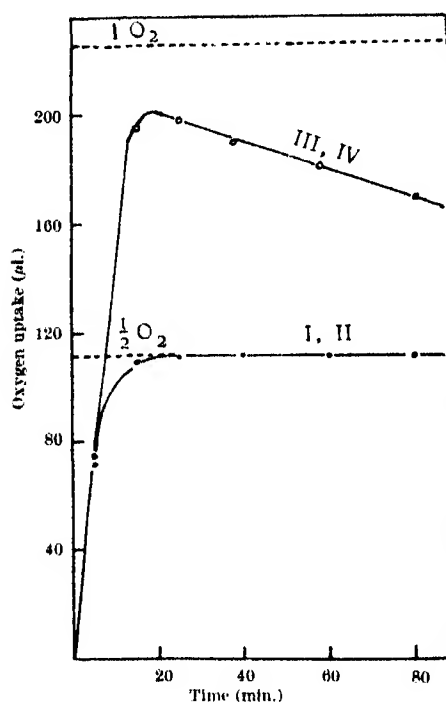


Fig. 1.

(I). 2 ml. enzyme, 0.5 ml. *M*/50 PYOCYANINE, 0.2 ml. *M*/10 dl-SODIUM- α -GLYCEROPHOSPHATE.

(II). 2 ml. enzyme, 0.5 ml. *M*/50 PYOCYANINE, 0.5 ml. 0.3 PER CENT COENZYME I, 0.2 ml. *M*/10 dl-SODIUM- α -GLYCEROPHOSPHATE.

(III). SAME AS I + 0.2 ml. *M*/2 CYANIDE.

(IV). SAME AS II + 0.2 ml. *M*/2 CYANIDE.

reported an acceleration of the reaction by coenzyme I³, the assumption was made that the preparations of α -glycerophosphoric dehydrogenase contained another enzyme oxidizing the triosephosphate further to phosphoglyceric acid and depending on coenzyme I. Such an enzyme has been found in yeast⁴. In that case half a molecule of oxygen per molecule of α -glycerophosphoric acid should be taken up in absence of coenzyme I and one molecule in its presence. It is possible that in such a case, with an excess of α -glycerophosphoric acid, no acceleration

of the initial velocity of the reaction by coenzyme I would be produced. This hypothesis, however, could not be verified. Only half a molecule of oxygen is taken up per molecule of α -glycerophosphoric acid with and without coenzyme I (Fig. 1).

Supplementary to Green's work, the interesting observation may be added that with our enzyme preparation the final value of the oxygen uptake was almost doubled in presence of cyanide. This is no doubt due to an inhibition of catalase and formation of hydrogen peroxide, which can be demonstrated by the titanium sulphate reaction. The three carriers give the same result. A slow and steady evolution of gas is observed after the reaction is completed owing to the slow decomposition of this peroxide (Fig. 1). This explains the 'stimulating' effect of cyanide on the rate of reaction observed by Green.

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Sept. 21.

¹ Green, D. E., *Biochem. J.*, **30**, 629 (1936).

² v. Euler, H., Adler, E., Günther, G., and Hellström, H., *Hoppe-Seyl. Z.*, **243**, 217 (1937).

³ Dewan, J. G., and Green, D. E., *Biochem. J.*, **31**, 1074 (1937).

⁴ v. Euler, H., Adler, E., and Günther, G., *Hoppe-Seyl. Z.*, **249**, 1 (1937).

⁵ v. Euler, H., Adler, E., and Hellström, H., *Hoppe-Seyl. Z.*, **241**, 230 (1936).

The Effect of Enol-Esters of Testosterone

ENOL-ESTERS from the series of male sex hormones were first prepared by L. Ruzicka and W. H. Fischer¹. Experiments carried out in our laboratories showed that testosterone diacetate was less active on the capon's comb than the testosterone monoacetate, but that in single injection (2 mgm.) it was more active than testosterone monoacetate on rats². Deane and Parkes³ recently compared the effect of testosterone monoacetate and testosterone diacetate, and the results of their experiments indicated that these two substances are similar as regards activity. In the meantime, our experiments were extended to the previously described dipropionate and also to two newly prepared enol-esters of testosterone. The technique corresponds to that earlier described by Miescher, Wettstein and Tschopp⁴.

TABLE 1.

Testosterone Esters	Int. Unit measured on the capon's comb	Max. effect is attained on the
Testosterone-3, 17-diacetate ..	35 γ	10th day
" -3-acetate-17-propionate, 140-141° F. ..	40 γ	12th "
" -3, 17-dipropionate ..	45 γ	14th "
" -3-acetate-17-n-butyrate, 97-98° F. ..	200 γ	15th "
" -17-acetate ..	20 γ	7th "
" -17-propionate ..	20 γ	9th "
" -butyrate ..	60 γ	12th "

Capon's comb. As will be seen from Table 1, the effect of testosterone diesters on the capon's comb is in general less intense but rather more prolonged than that of the mono-esters.

Rats. Fig. 1 shows that also in the 10-day test (10 daily injections; examination on the 11th day) the effect of the enol-esters on the seminal vesicles of castrated rats is less than that of, for example,

testosterone propionate (Perandren). The longer the chain of the acid groups the less the effect. This also applies to the prostate.

A different picture is obtained if merely a single injection (2 mgm.) is given and the total temporal course of the effect is considered. The activity of testosterone diacetate on the seminal vesicles (Fig. 2) is between that of the monoacetate and that of the propionate. The remaining enol-esters, however, exercise a much more intensive influence. With these the maximum effect is considerably higher and is reached considerably later. Of all known compounds of the male sex hormone series, testosterone-3-acetate-17-butyrate exhibits the most prolonged effect. Forty days after a single injection, the weights of the seminal vesicles and prostate amounted to 140 mgm. and 190 mgm. respectively, and attained on the 50th day 90 mgm. and 160 mgm. respectively (controls: 14 mgm. and 45 mgm. respectively). In comparison the duration of the effect of a similar dose of testosterone is seven days and that of a similar dose of testosterone propionate about twenty days.

The utilization of testosterone by the organism varies apparently according to the degree of esterifica-

tion. An efficiency coefficient is calculated by comparison of the surfaces bounded by the respective

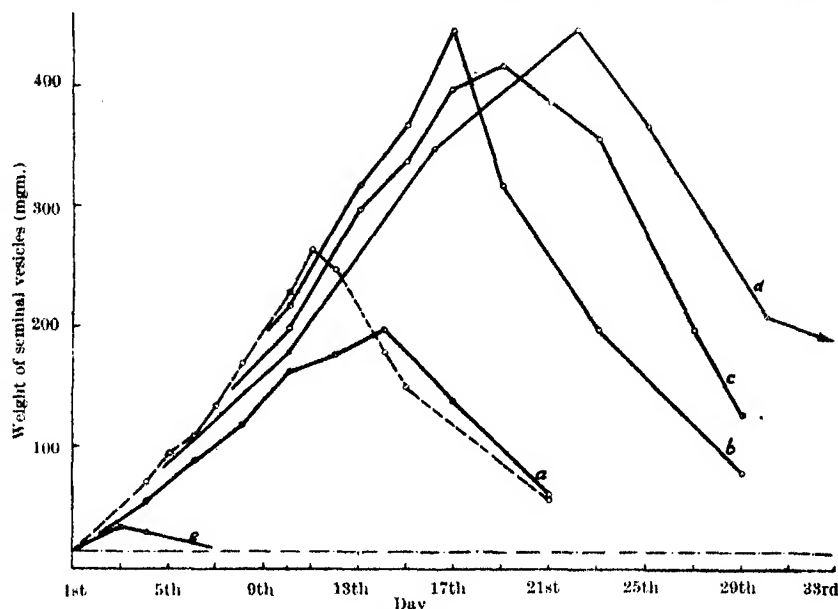


Fig. 2.

EFFECT OF TESTOSTERONE ENOL-ESTERS ON THE WEIGHT OF SEMINAL VESICLES (METHOD OF SINGLE INJECTION).

a: T-3,17-diacetate; b: T-3-acetate-17-propionate; c: T-3,17-dipropionate; d: T-3-acetate-17-n-butyrate; e: testosterone. T = testosterone. Broken curve: T-17-propionate.

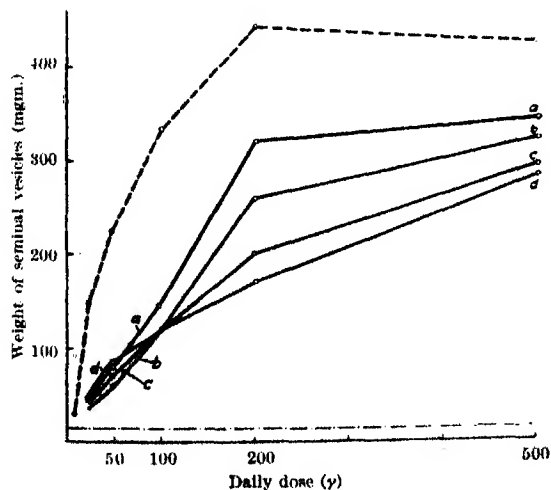


Fig. 1.

EFFECT OF TESTOSTERONE ENOL-ESTERS ON THE WEIGHT OF SEMINAL VESICLES (METHOD OF TEN INJECTIONS).

a: T-3,17-diacetate; b: T-3-acetate-17-propionate; c: T-3,17-dipropionate; d: T-3-acetate-17-n-butyrate. T = testosterone. Broken curve: T-17-propionate.

tion. An efficiency coefficient is calculated by comparison of the surfaces bounded by the respective

than when measured on the prostate. Based on equimolecular quantities the efficiency coefficient of the esters would be still more favourable.

TABLE 2.

EFFICIENCY COEFFICIENT OF THE ESTERS*, BASED ON TESTOSTERONE AS THE UNIT, USING SINGLE INJECTIONS OF 2 MGm.

Testosterone Esters	Seminal Vesicles	Prostate
Testosterone-3, 17-diacetate	28	25
" -3-acetate-17-propionate	77	51
" -3, 17-dipropionate	90	62
" -3-acetate-17-n-butyrate	137	81
" -17-propionate	33	23

* Determined by estimating the completion of the curves.

The hypothesis put forward earlier², that enol-esters of testosterone belong to the most active hormones, has been confirmed on rats (but not on capons). In the ten-day test, the enol-esters appear to have a lesser activity, but this is due to a somewhat delayed onset of effect; their maximum effect being attained much later than on the eleventh day. Similar investigations to those dealt with in this report should be carried out on other animals, as apparently the efficiency coefficient varies according to the different species of animals.

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"Ciba" Research Laboratories, W. H. FISCHER.
Basle.
Sept. 1. E. TSCHOPP.

¹ Ruzicka, L., and Fischer, W. H., *Helv. chim. Acta*, **19**, 806 (1936).

² Ruzicka, L., and Fischer, W. H., *Helv. chim. Acta*, **19**, 1371 (1936).

³ Deanealy, R., and Parkes, A. S., *Biochem. J.*, **31**, 1161 (1937).

⁴ Miescher, K., Wetstein, A., and Tschopp, E., *Biochem. J.*, **30**, 1970, 1977 (1936).

Changes in Chloroplast Pigments in Leaves during Senescence

Loss of chlorophyll in senescent leaves is a general phenomenon, and various views have been put forward to explain how chlorophyll disappears as the leaf yellows. The possibilities recognized are: (1) the decomposition of chlorophyll into its basic components and the transference of the latter to places of storage; and (2) the transformation of chlorophyll into certain substances likely to function during senescence.

Meyer¹ suggested that chlorophyll decomposes and is then borne away, while the yellow pigments remain as they were in the leaf. His conclusion having been reached without any quantitative estimations, it can only be regarded as tentative. Swart² concludes that chlorophyll is decomposed and nitrogen translocated. Stoklasa, Senft and Sebor³ believe that the autumnal changes of colour depend on the hydrolytic fission of chlorophyll and the formation of pheophytin and phosphatids.

In the course of our studies on the seasonal variations in the chloroplast pigments of tropical plants, the data obtained pointed to the possibility of a conversion of chlorophyll to carotenoids during the yellowing of the leaves.

Leaves of *Bassia latifolia* examined passed through the following stages during senescence; after dark green, bright green 10 days, green 15 days, yellow green-yellow 8 days (at this stage yellow spots appeared along the marginal veins), almost yellow 2 days and then bright yellow. The results of the pigment analysis at these successive stages are set forth in the accompanying table.

Stage of senescence	Chlorophyll*	Carotin*	Xanthophyll*
Dark green	23.68	9.34	7.21
Bright green (5 days after the dark green stage)	17.95	10.41	7.91
Green (15 days after the dark green stage)	11.34	11.05	8.34
Yellow green-yellow (30 days after the dark green stage)	6.25	16.05	11.72
Almost yellow (36 days after the dark green stage)	1.16	17.25	14.21
Shedding (42 days after the dark green stage)	0.00	3.45	2.10

* Expressed as mgm. per 10 gm. of dry weight.

The chlorophylls ($a + b$) were determined by the procedure recently developed by us⁴: the measurement of light absorption of an alcoholic extract (80 per cent methyl alcohol) of plant pigments within a narrowly defined region of the spectrum, for which the chlorophylls ($a + b$) possess a marked absorption, while the absorption of the other pigments is infinitesimal. Carotin and xanthophyll were determined by a new spectrophotometric method, a description of which will appear shortly.

The data indicate that during the different stages of the yellowing of the leaf, as chlorophyll decreases, there is a corresponding rise in the carotenoids, the increase in carotin being more than that in xanthophyll. Further, at the shedding stage of the leaf, the carotenoids disappear almost completely.

On a consideration of the results presented here, in conjunction with the experimental results of Ewart⁵ that carotin is present in greater amounts

when chlorophyll is absent and carotin apparently decreases as chlorophyll increases, it appears that the increase in carotenoids during the yellowing of the leaves is a consequence of the disappearance and transformation of chlorophyll.

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N. K. ANANTHA RAO.

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Sept. 18.

Meyer, A., *Flora*, 85 (1918).

² Swart, N., *Jena* (1914).

³ Stoklasa, J., Senft, E., and Sebor, J., *J. Chem. Soc.*, 106 (1914).

⁴ Singh, B. N., and Anantha Rao, N. K., *Curr. Sci.*, 8, 416 (1937).

⁵ Ewart, A. J., *Proc. Roy. Soc. Victoria*, 80, 187 (1918).

River Flow around Bends

In two paragraphs in the News and Views columns of NATURE of September 18, a lecture on "Rivers", delivered in connexion with the recent meeting of the British Association by Mr. R. Kay Gresswell, was summarized. A statement made in this report requires comment on the ground that, while undoubtedly representing a view held by a considerable number of competent geographers, geologists, and others, it is at variance with the facts as established experimentally many years ago by the late Prof. James Thomson.

The statement was as follows: "In turning a corner, the speed on the outside of the curve is always greater than that on the inside. This results in the water on the outside being able to take an additional load and so erode the bank." The erosion of the bank is incontrovertible; it is universally in evidence, but Prof. Thomson's investigations showed that the erosion is not due, as alleged, to greater velocity on the outside of the curve. On the contrary, the velocity there is less than on the inner side of the bend.

Prof. Thomson's explanation of the matter is contained in papers contributed to the Royal Society (*Proc.*, 26, 356) and the Institution of Mechanical Engineers (*Proc.*, p. 456; 1879). I have not the original papers at hand, but I venture to quote as follows from the authoritative article on "Hydro-mechanics" by the late Prof. W. Cawthorne Unwin, in the "Encyclopedia Britannica" (ninth edition, 1881, vol. xii):

"When water moves round a circular curve under the action of gravity only, it takes a motion like that in a free vortex. Its velocity is greater parallel to the axis of the stream at the inner than at the outer side of the bend. Hence the scouring at the outer side and the deposit at the inner side of the bend are not due to mere difference of velocity of flow in the general direction of the stream; but, in virtue of the centrifugal force, the water passing round the bend presses outwards, and the free surface in a radial

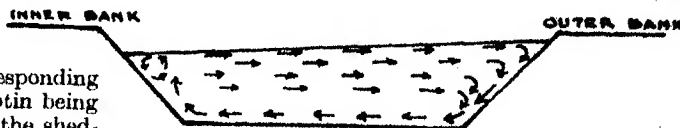


Fig. 1.

cross section has a slope from the inner side upwards to the outer side (Fig. 1). For the greater part of the water flowing in curved paths, this difference of

pressure produces no tendency to transverse motion. But the water immediately in contact with the rough bottom and sides of the channel is retarded, and its centrifugal force is insufficient to balance the pressure due to the greater depth at the outside of the bend. It, therefore, flows inwards towards the inner side of the bend, carrying with it detritus which is deposited at the inner bank."

This explanation of Prof. Thomson's, which he completely verified by experiment, has long been known to, and accepted by, river engineers, and it is unfortunate that, through unawareness of it, an incorrect, though admittedly plausible, view of the action of rivers at bends should still be entertained and disseminated.

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Gravitational Statics in Three Dimensions

THE commonly accepted case for three-dimensional gravitational statics is far from complete. On the Faraday tube hypothesis, a diagram shows that gravitational tubes of force attract laterally and exhibit a thrust longitudinally. Each pressure is $g^2/8\pi G$ dyne.-cm.⁻², where g is the field intensity and G Newton's constant. The field has energy $-g^2/8\pi G$ erg.-cm.⁻³, the negative sign holding because if work is done against, that is, added to the field, for example, by expanding a sphere, the numerical value of the field's energy-volume integral is diminished, positive and negative energy being annihilated in the process, which naturally is reversible.

By the mass-energy relation, which, of course, need not be taken as proceeding from four-dimensional theory, we are forced to ascribe to the field a mass-density, $-g^2/8\pi G c^2$ gm.-cm.⁻³, and we have

$$\text{div } g = -4\pi G \rho + \frac{g^2}{2c^2}, \quad \dots (1)$$

where ρ is the positive mass-density at the point. Corresponding to electricity, the conceptions of negative mass and energy are gravitational only; inertially, they are absurd.

Applying (1) to a sphere of mass M , uniform density ρ , and radius R , the internal field is given by

$$g = kc \tanh \frac{kr}{2c} \quad \dots (2)$$

where $0 < r < R$ and $k = (8\pi G \rho/3)^{1/2}$. Now, keeping $r < R$ let both tend to infinity. g tends to the constant value g , equal to kc , so that $-g^2/8\pi G c^2 = -\rho/3$. If these arguments are sound, they dispose of Einstein's objection¹ to an infinite Newton-Faraday universe. Again, if $g = g_0$ when $r = R$, we get

$$4\pi R^3 g_0 = 4\pi G M \sqrt{\frac{2}{\gamma}} \tanh \sqrt{\frac{\gamma}{2}} \quad \dots (3)$$

where $\gamma = GM/c^2 R$. That is, the number of unit tubes threading the surface varies even with M constant.

The external field is given by

$$g = \frac{G \Delta}{\left(1 + \frac{1}{2} \frac{G \Delta}{c^2 R}\right) r^2 - \frac{1}{2} \frac{G \Delta}{c^2} r} \quad \dots (4)$$

where $R < r < \infty$, and Δ is defined by $g_0 R^3 = G \Delta$,

being related to M by (3). If $\gamma \ll 1$ and $r \gg R$, then in (4) we may replace Δ by M and reject the second term in the denominator on the right hand side. Differentiating, we get

$$\frac{\partial g}{\partial M} = \frac{G}{r^2} \left(1 - \frac{5}{6} \gamma\right),$$

which is simply the relativistic claim that a particle apparently loses mass when lowered slowly into a gravitational field.

Finally, since the field is not a true inverse square, it is not in equilibrium, the resultant force being clearly directed towards expansion. To approximate the conditions in our own universe, treated as a huge sphere the constituent particles of which are free to move, if we exclude all sources of energy-supply for this force but the field itself, spontaneous expansion will begin only if the total field energy can become more negative in the process so as to allow the further creation of positive energy. Actually, our universe cannot be infinite for its observed expansion would then be meaningless. This is impossible if $\gamma \ll 1$, but when γ compares with unity, it has a range of values satisfying this condition. Thus the recession of the spiral nebulae is due, not to real repulsion, but to the field's intrinsic instability, and, *ceteris paribus*, such an expansion, once started, would become oscillatory. These high values of γ for a sphere make the total field energy comparable with the total positive energy, and exact evaluation (which for one of the two necessary integrals does not appear to be simple) would probably reveal that the algebraic sum of the quantities of all forms of energy is zero under these conditions. Applied to our universe, such a result is manifestly philosophically necessary and conclusive.

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Sept. 20.

¹ Einstein, A., "Relativity. The Special and the General Theory", pp. 105-106.

Snow Crystal or Snowflake

IN the introduction to his useful summary in NATURE of August 28, p. 345, of Prof. U. Nakaya's physical investigation on falling snow, Mr. G. Seligman writes: "he [Prof. Nakaya] proposes to continue to call a particle of falling snow a 'snow crystal' in preference to my 'snowflake'. As all snow, whether falling or having lain on the ground for months, is crystalline, the word 'snow crystal' is likely to lead to ambiguity. I admit that 'snowflake' ('simple' for a single crystal; 'compound' for an assemblage) is not perfect, but until a better word is devised it must, I fear, remain."

I regret to have to disagree with Mr. Seligman, who is doing so much to revive the study of snow and glaciology in Great Britain, but I cannot accept his use of the word snowflake to describe the single ice crystals of which snow is composed. In the choice of scientific words great care must be taken not to extend the meaning of words in common use beyond their ordinary significance. Now the compound word 'snowflake' has a very definite meaning in the English language and is applied only to that variety of atmospheric precipitation which occurs in the form of loosely cohering masses of ice crystals. To quote

the "Concise Oxford Dictionary": "Flake—light fleecy tuft or piece, esp. of snow." It is the 'fleecy' quality which is essential to a snowflake, and this fleecy quality is given by the cohering together of a number of ice crystals. It is, therefore, an inadmissible extension of the word snowflake to apply it to the individual ice crystals composing the flake, which have nothing fleecy about them and would not be described as snowflakes if exhibited individually to anyone familiar with the English language but unacquainted with the nature of snow.

I may mention that Prof. Nakaya's use of the terms snowflake and snow crystal is in full agreement with the practice of the Meteorological Office as set out in the "Meteorological Glossary" published by the Office.

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Sept. 7.

I AGREE with Sir George Simpson that the word 'snowflake' is not a perfect description of a single ice crystal falling as snow (indeed I said so in the passage which he quotes), but can a better be found?

'Snow crystal' is not good, for after having fallen the snow particles remain snow crystals or crystallites right through the *firm* stage until they become the ice crystals of pure glacier ice. Therefore in a description of snow phenomena it is continually being found that some separate designation is required to differentiate between snow crystals in the falling and the fallen states, *the more so because their characteristics in the two states are quite different.*

My 'flake' is not quite so bad as Sir George suggests, for I chose it after consulting "Webster's Dictionary", which gives: "A loose, filmy or scale-like mass; a film; a flock; lamina; . . . and on turning to 'lamina' I find: "A thin plate or scale."

I may say that Prof. Nakaya has now accepted my nomenclature; nevertheless, I am still not completely satisfied with it and will gladly accept a better name for the particle of fallen snow, though not, I fear, the appellation 'snow crystal' which, as I have tried to show, applies equally to the falling and the fallen condition, and is therefore ambiguous.

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(Chairman of the British
Group of the International
Commission of Snow.)

Points from Foregoing Letters

A PHOTOGRAPH showing an enlargement of the green mercury line in the third-order spectrum obtained by means of an aluminized diffraction grating with 30,000 lines to the inch is submitted by Prof. R. W. Wood. Gratings with 15,000 lines to the inch give high concentration of light in the first-order spectrum and have been used with very good results at Mt. Wilson Observatory. Replicas of such gratings made by flowing on them a nitro-cellulose solution have been successfully used by the Lick and Harvard Observatories for studying the extreme red and infra-red spectra of the stars, and for obtaining the distribution of the different gases in nebulae. Prof. Wood hopes to prepare both plane and concave gratings by the use of plastics and a moulding process.

A table showing the wave-lengths of a number of new lines in the spectrum of the corona observed during the solar eclipse of June 19, 1936, is given by Prof. R. Sekiguti, who discusses some of the features of the spectrogram. The new observations confirm the existence of the line 4725 Å. This and other lines are close to certain lines in the spectra of nebulae and novae. Prof. F. J. M. Stratton remarks that if Prof. Sekiguti's identification is accepted, then in the lines 6548 and 6584 we have evidence, for the first time, of a known element in the corona, since these lines are ('forbidden') lines in the spectrum of nitrogen (N II).

Experiments by Prof. G. Hevesy, Dr. K. Linderström-Lang and N. Nielsen indicate that, unlike plants, yeast cells immersed in a solution containing 'labelled' (radioactive) phosphorus atoms (as phosphates) do not take up or exchange such atoms. This may mean either that all the phosphorus in the yeast is in bound organic form (as hexosephosphates or adenyphosphoric acid) or that yeast cells are impermeable to phosphate ions except when growing.

Dr. H. Weil-Malherbe finds that the addition of

coenzyme I to α -glycerophosphoric dehydrogenase does not affect its ability to take up oxygen and to dehydrogenate α -glycerophosphoric acid. A powerful dehydrogenating enzyme was obtained from horse brain by using pyocyanine as carrier.

Dr. K. Miescher, W. H. Fischer and E. Tschopp report on the effect of enol-esters of testosterone on the capon's comb and on the sexual organs of the rat. They state that the enol compounds produce on the rat, but not on the capon's comb, the strongest and longest duration of all hitherto known male hormones.

Prof. B. N. Singh and N. K. Anantha Rao find that in the tropical plant *Bassia latifolia*, as the leaves grow old and the amount of green colour (chlorophyll) decreases, there is an increase in the carotin and xanthophyll colouring matter, but these also disappear almost completely at the shedding stage of the leaf.

Dr. B. Cunningham points out that the widely held view that, at a river bend, the speed of the water on the outside of the bend is greater than on the inside, does not agree with the observations of the late Prof. J. Thomson. He found a vortex type of motion which led to the velocity being greater on the inner side of the bend. The erosion of the outer side is due, in these circumstances, to a transverse current of water which flows along the bottom towards the inner side, carrying with it detritus.

S. D. Emslie develops the Faraday tube hypothesis for the treatment of gravitation and, by introducing the mass-energy equation, arrives at a relation for the field intensity which, he claims, disposes of Einstein's objection to an infinite Newton-Faraday universe. Further considerations lead him to the view that the recession of the spiral nebulae is due, not to a real repulsion, but to the field's intrinsic instability, so that an expansion once started would become oscillatory.

Research Items

Palaeolithic Man in Norfolk

SOME time ago, Mr. J. E. Sainty made known the discovery of a palaeolithic hand-axe at South Acre, Norfolk (*Proc. Preh. Soc. E. Anglia*, 7, Part 3). More recently he has found others lying upon the stone heaps in the pit, and there is little doubt that these specimens are referable to some phase of the Clacton III industry. During September, Mr. Reid Moir and Mr. J. B. Calkin visited South Acre and found, at a depth of about 15 ft. in the deposit, exposed there upwards of forty Clacton flakes and rough-outs. This deposit is of a remarkable character, being composed of great numbers of large flints and other stones embedded in a hard sandy matrix very rich in manganese. The gravel—if such it can be called—exhibits no signs of stratification, but is contorted and twisted by glacial action or solifluxion to a marked degree. Though this is the case, and while it is claimed by some that the process of solifluxion inevitably gives rise to extensive flaking upon flints, transforming them into rostro-carinate and other early forms, it is significant that the Clactonian specimens from South Acre show no signs of such flaking. They are patinated white, and in nearly every case show little or no abrasion. The deposit in which they are found is clearly to be correlated in time with the uppermost Cannonshot gravel of Norfolk, which in its turn equates with the Upper Chalky Boulder Clay of Suffolk. The South Acre implements were made, therefore, at the close of the well-known Hoxne interglacial period, which intervened between the deposition of the Kimmeridgian and Upper Chalky Boulder Clays. Moreover, at Slindon in Sussex, Mr. Calkin discovered a palaeolithic floor resting upon a raised beach and covered by Coombe Rock. The specimens from this floor are precisely similar to those from South Acre both in their forms, technique and condition; and the deposits at both sites rest at 124–130 O.D., while each also is rich in manganese, which has attached itself freely to the flint implements. Thus, it is now possible to link up the Coombe Rock of Slindon with the South Acre deposit, and this with the Upper Chalky Boulder Clay. It is evident that the glaciation responsible for the laying down of these various deposits was of no mean order. The South Acre gravel is more than 20 ft. in thickness, while as far south as Slindon a considerable deposit of Coombe Rock was accumulated.

Research at Cullercoats

THE report of the Dove Marine Laboratory, Cullercoats, Northumberland, for the year ending July 31, 1936, published by the Marine Laboratory Committee of Armstrong College (1937) and drawn up by the director, Prof. A. D. Hobson, shows a very satisfactory progress in all directions. Herring investigations by Mr. Storrow and Mrs. Cowan, chiefly on behalf of the Ministry of Agriculture and Fisheries, continue as before, and observations are also made on the Tyne salmon, a full account of which has already been published in the annual report of the Tyne Salmon Conservancy Board for 1936. The mussels in the Eak Estuary were examined on behalf of the North-Eastern Sea Fisheries Com-

mittee in view of increasing bait supply. Transplantation of several tons of mussels has given good results, and it is recommended that further supplies be transplanted. Dr. Bull continues his studies on conditioned responses in fishes. He has now begun to investigate the ability of fishes to perceive alterations in the rate of current flow. Special attention is given to those environmental factors which might be expected to affect purposive movements of fishes or condition their migration, most of this work being of a pioneer nature. Papers on herring investigations and on mussel transplanting are included in the report, and in addition there are two very interesting contributions, "The Development of *Capitelloides giardi* Meunil" by J. A. Day, which was breeding in the aquarium and offered a good opportunity for study of the life-history, and "Notes on the British Species of the Genus *Galathea* Fab.", by H. O. Bull. The latter effectively solves the much-debated problem concerning the validity of the species *Galathea nera*, which is shown both in structure and in the nature of the larva to be a distinct species.

Plant Ecology of Limestone Pavements

IN a paper read before Section K (Botany) of the British Association meeting at Nottingham, Miss A. Bennett discussed the ecology of the limestone pavements at Hutton Roof and Farleton, Yorkshire. Vegetation of limestone areas depends on three types of ground configuration, namely, pavements, escarpments and screes. Exposure to weather and angle of slope control the accumulation of soil and hydrogen ion concentration, and these of course affect the type of vegetation. One important biotic factor is that of grazing, which keeps the vegetation at the subclimax stage. A certain mixture of plants occurs owing to invasion of vegetation from nearby siliceous soils. The detailed distribution of certain species has been studied. For example, the bane-berry (*Actaea spicata*), has been recorded as following a fault, but being unable to traverse a ten-mile glacial drift. As a dynamic ecological hypothesis, formulated from her records of the static ecology, the author suggests that in this area certain virgin country is being colonized and in others denudation has occurred and the vegetation is retreating.

Metamorphic Rocks of Unst, Shetland Island

PROF. H. H. READ has dealt with the polymetamorphic rocks of the Valla Field Block, one of the tectonic units of Unst. (*Trans. Roy. Soc. Edinburgh*, 59, Part 1 (6), 195–221; 1937). The metamorphic history of this block has been divided into three stages, each characterized by the type of pressure-temperature factors then operative. The First metamorphism was controlled by fairly high temperature and considerable stress; the Second by lower temperature and much greater stress; and the Third by low temperature and very localized strong stress. In true pelitic rocks, three distinctive mineral assemblages characterize the three metamorphic episodes. In calcareous rocks, diopside-bearing rocks of the First metamorphism are replaced by tremolite-bearing rocks in the Second, and the tremolite is

mechanically deformed during the Third. The change from diopside to tremolite takes place under about the same conditions as the change from biotite to chlorite in pelitic rocks. In rocks of other types—siliceous, hornblende, pegmatites and injection-rocks—the mineral assemblages of the First metamorphism are stable throughout the Second and Third, though these minerals are deformed and often completely shredded-out during the later episodes. The general conclusion is advanced that in retrogressive metamorphism the stability of an assemblage depends on the bulk-composition of the rock, and that no mineral can be considered adequately apart from the rock in which it occurs.

Distribution of Electricity in Thunderclouds

Sir George Simpson and F. J. Scrase (*Proc. Roy. Soc., A*, 161, 309) have investigated the distribution of electricity in thunderclouds by a very direct method. A sounding balloon carries a trailing wire about 20 m. long terminated by a point at the lower end and a system of points at the upper end. When the balloon goes through a region of high potential gradient a point-discharge current flows in the wire. In a break in the circuit a paper disk soaked in a chemical solution is included, and the passage of a current leaves a characteristic discoloration at the positive electrode. The disk is rotated by a clock, and the direction of the point discharge current can be obtained from the traces. An idea of the magnitude of the potential gradient could be obtained from the width of the trace, and when the currents were very large the paper was charred by sparking. The height of the balloon was recorded continuously. Simultaneous records of electric field near the ground were taken. The results show that the most typical thundercloud has a positive charge at the top, a negative charge over most of the remainder, and a concentrated region of positive charge somewhere near the base. The authors consider that the breaking-drop theory of Simpson explains the concentrations of positive charge in the base of the cloud. The explanation of the positive electrification at the top of the cloud is sought in the presence of ice crystals or snow in these regions, which become electrified by friction or in some other way. The explanation given by C. T. R. Wilson, involving the electrical polarization of the falling drops, is held to be invalidated by the low temperatures of the relevant regions in the cloud, which are supposed to contain ice crystals rather than water drops. The paper contains considerable discussion of the configurations of thunderclouds. The results are not inconsistent with the idea that the circulation of electricity in the atmosphere is maintained by thunderstorms and shower clouds.

Absorption Edges in the Soft X-ray Region

H. W. B. Skinner and J. E. Johnston (*Proc. Roy. Soc., A*, 161, 420) have investigated the structure of the absorption edges of some metals in the wave-length region 100–300 Å. These edges correspond to transitions from an inner electron shell to the conduction-electron levels of the metal, and their fine structure therefore provides a method of investigating the distribution of the conduction levels. The spectrographic apparatus is a concave grating used at a small grazing angle, and Ilford Q plates are used. The absorbing metals were used as thin foils obtained by evaporation on to a celluloid film supported

on naphthalene which was then sublimed away. No light source giving a continuous spectrum was available, and a condenser spark in vacuum, usually with copper or silver electrodes, was used. A special technique of photographic photometry was developed to deal with the difficult conditions of a fluctuating source of line spectrum. Absorption curves were obtained for the *K* edge of Li in the metal and in LiOH, the *L* edges of Mg, and the *M* edges of Cu, Ni. A paper connecting these edges with the electron theory of metals is promised.

Ionosphere Disturbances

Dr. J. H. DELLINGER has summarized the results obtained by the world-wide co-operative study of the fading out of high-frequency radio transmission for short periods during daylight, and the simultaneous perturbations of terrestrial magnetism (*J. Research, U.S. Bur. Stand.*, August 1937). Half the 118 disturbances investigated were accompanied by solar eruptions seen as sudden increases of brightness of large patches of the sun's surface. A detailed discussion of the observations leads Dr. Dellinger to the conclusion that the whole of the effects may be explained as due to an increase of ionization of a *D* layer of the atmosphere below the already known *E*, *F*₁ and *F*₂ layers at heights 120 km., 220 km. and 320 km. respectively, at which radio waves are as a rule reflected. This ionization, he considers, is due to an electromagnetic radiation of a penetrating type and of a frequency far greater than that of light, emitted in all directions from eruptions on the surface of the sun. During the eighteen months of observation there is some indication of a 55-day period in the disturbances. Further observations are likely to add materially to our knowledge of the sun.

Pierre Gassendi (1592-1655)

A SHORT memoir, entitled "L'Œuvre Astronomique de Gassendi" by Prof. P. Humbert of the University of Montpellier recalls the work of one of the most notable observers in the first years of telescopic astronomy (*Actualités scientifiques et industrielles*, 378. Pp. 32. Paris: Hermann et Cie., 1936. 8 francs). Pierre Gassendi was a philosopher, theologian, mathematician and, pre-eminently, an astronomical observer whose precise records of observations might well serve as precepts to be followed by astronomers of the present day. He was a diligent observer of sunspots (especially from 1620 until 1626), a joint compiler with Peiresc of one of the first maps of the moon, an observer of a number of solar and lunar eclipses between 1621 and 1654, of occultations, planetary phenomena, the comets of 1618 and 1652, the great aurora of 1621, and of parhelia. But perhaps the observation which gave him the greatest pleasure was that of the transit of Mercury on November 7, 1631, which Kepler had predicted in 1629. This first observation at Paris ever made of a transit of Mercury had its counterpart in England in 1639, when Horrocks and Crabtree observed the rarer phenomenon of a transit of Venus across the sun's disk—the sole prediction of which Horrocks had derived just before the event when working on his corrections of Kepler's Rudolphine Tables of 1627. Eight years earlier, Gassendi had, indeed, watched the sun's disk on four consecutive days for the transit of Venus of 1631, as predicted by Kepler, but the transit took place on December 6 when inaccessible to observation from Europe.

Invertebrates of the Faroes*

PUBLISHED at the expense of the Carlsberg Fund and accordingly sold at a very reasonable price, this monograph will appeal to a wide circle of workers interested in taxonomy and geographical distribution.

Most of the sections on marine Crustacea are by K. Stevensen and, of the Decapoda, twenty-nine species are now known from these islands. The majority of them seem to be rare, having only been taken a few times, or even a single time, and only six species are really abundant. Although the Faroes are only about 160 miles from the Shetlands, their Decapod fauna is comparatively poor, since the last-named islands contain forty-eight or forty-nine species. It seems that the deeps south-east of the Faroes are impassable to numerous littoral and sub-littoral species. Of the Amphipoda only twelve species were previously known, while the present work brings up their number to no fewer than sixty-one species. The greater number of these belong to the epi-fauna (living among algae or Hydroids, etc.) and the majority are common north-west European or arctic-boreal species. Previous records of the Isopoda and Tanaidacea are contained in works of H. J. Hansen (1913 and 1916). The present work contains only two species not listed by this author. Of the Mysidacea, Cumacea and Nebaliacea, only seven species are at present recorded, which is a very small number as compared with ninety-eight species for surrounding waters (Iceland, Shetlands (or Scotland) and Norway).

Of the Cirripedes it is noteworthy that six species were known from the Faroes so long ago as the year 1800 and, since then, only five have been added to that number. The marine Ostracoda have hitherto remained almost totally unknown and, in the present work, fifteen species are dealt with, but some of them could not be named with certainty. The majority are widely distributed and common. The fresh-water Crustacea are discussed by E. M. Poulsen, and

forty-one species are enumerated: while they show features recalling the more arctic regions, those of temperate zones predominate.

Of other Arthropods, P. Hammer and K. L. Henriksen discuss the Myriapoda, of which seven species are identified: all these occur also in Britain excepting the Chilopod *Pachymyrmex ferrugineum*. Among the Insecta, K. L. Henriksen describes the members of several of the smaller orders. The only Thysanuran recorded is *Petrobius balticus*, a species often confused with *P. maritimus*. Of the thirteen species of Collembola the main part consists of Palearctic forms, widely distributed on the Continent as well as in Great Britain. The only Orthoptera are *Forficula auricularia* and *Blatta orientalis*. The Mallophaga comprise thirty-one species, but this total is obviously incomplete since no parasites off the puffin are recorded. While dragonflies, mayflies and stoneflies are unrepresented, and there is only a single Neuropteran (*Borionymia betulina*), seventeen species of Trichoptera are recorded. In the account of the Lepidoptera by N. L. Wolff thirty-two species are enumerated. The only butterflies are *Pyrameis atalanta* and the cosmopolitan *P. cardui*. None of the moths is endemic.

The concluding part of the volume is A. West's account of the Coleoptera, wherein some 156 species are enumerated. The Carabidae, with twenty-six species, and the Staphylinidae, with sixty-five species, are the only two large families at all well represented. A predominating feature is the close resemblance of the Coleopterous fauna of the Faroes with that of Scotland and Norway. Only five Faroese species have not been found in Scotland and only three have not been discovered in Norway, while sixty-three species do not, apparently, occur in the Shetlands. The last-named islands, however, have not been so thoroughly investigated as the Faroes. The orders Hemiptera, Diptera and Hymenoptera are not included in the present issue.

When complete the work will be published in three volumes, each in two parts. The whole is expected to be completed in 1938.

A. D. IMMS.

* The Zoology of the Faroes. Edited by Ad. S. Jensen, W. Lundbeck, Th. Mortensen and R. Spärok. (Published at the expense of the Carlsberg-Fond.) Vol. 2, Part 1: Crustacea, Myriopoda, Insecta I. Pp. III+346. (Copenhagen: Andr. Fred. Høst and Son, 1937.) 15s.

West Middlesex Main Drainage

THAT part of the county of Middlesex lying to the west of the Finchley and Barnet Ridge has an area of about 160 square miles and is drained by four main streams, the Colne, the Ash, the Crane and the Brent and their tributaries, all of which flow to the Thames above London. In the post-war years the population and industries of this district increased and developed so rapidly that the twenty or more local authorities acting individually were unable to keep pace with the requirements, particularly in respect of sewerage and sewage disposal. Mr. David Mowat Watson has given the history of the scheme which was adopted to deal with this problem, and a description of the works and their design and construction (*J. Inst. Civ. Eng.*, April), for which he has just been awarded the Telford Gold Medal of the Institution of Civil Engineers.

In 1921 the average density of population per acre was 4.8 and in 1931 this figure had risen to 7.5, the greatest density in this latter year being 25.5. For the purposes of design an ultimate average of 23 was assumed, and the maximum rate of flow provided for was 240 gallons per head per day. The Act of Parliament which authorized the scheme empowered the County Council to construct trunk sewers for a wet weather flow of this amount, to make the necessary connexions with local sewers, to provide for gauging the sewage flow from each of the constituent authorities, to build purification works at Mogden with outfalls to the Thames at Isleworth Ait, and sludge disposal works at Perry Oaks.

Owing to the abnormally rapid development of the area, the Ordnance maps were out of date, the district had to be re-surveyed and about seventy

miles of existing sewers located. Over the greater part of the district the clay is overlaid with about twenty feet of water-bearing ballast and, to avoid trouble, the sewers were located in the clay, in which tunnelling is comparatively easy. In this connexion, the author notes that the contractors showed a growing preference for tunnelling, as it eliminated the heavy road charges and the costs and delays of diverting gas, water and other mains which open trench work involves.

A circular section was adopted for all sizes of sewers, as the higher velocity at low flows which might be expected from the egg-shaped section was deemed to be outweighed by the advantages of lower cost, increased resistance to external pressure and less loss of head. The lining of the larger sewers was best engineering brickwork, while pipes of aluminous cement were principally used in those less than 4 ft. in diameter. Although these tubes have a smoother surface initially, it was held that, over a long period, the average surface of brickwork is better; the roughness coefficients used in the Flynn-Kutter formula were 0.013 for brick, cast-iron and glazed stoneware, and 0.015 for cement pipes. The paper gives many valuable notes on the design of sewers, and describes the methods of effecting the junction of the local sewerage systems with the main trunk sewers. As the latter are at many points at a depth of 60 feet below ground, the design of backdrops and cascades forms an important feature, and several of

these and the methods of effecting flood relief of the rivers are illustrated.

For the purpose of ensuring that each district gets its fair share of the use of the sewers and of providing as much research information as possible of local storms and flows, a complete system of gauging has been installed. For various reasons, standing wave flumes were considered most suitable, and from tests made it is anticipated that a degree of accuracy of two per cent at full flow to six per cent at one thirtieth flow can be obtained.

At the Mogden works the purification of the liquid sewage is effected by the sludge activation process, and to ensure freedom from smell and also to utilize the available gas for power and heat, the sludge is subjected to complete anaerobic digestion. Large storm-water tanks have been constructed and these are in continuous use for partial treatment. In a partially digested state, the sludge is pumped seven miles to Perry Oaks, where the secondary digestion, drying and final disposal by tipping are carried out. The complete isolation of the drying beds from adjacent lands has been ensured by sinking a puddle wall through pervious clay and keying it into the London Clay. This method is regarded as unique, and was a necessary and wise precaution to prevent soakage finding its way into potable water. By means of this scheme, which was completed in May 1936, twenty-seven small sewerage works have been replaced by one large system.

Museums and the People

AT the present time museums, taking them all in all, are undergoing an interesting and critical stage of development. Some began and remain as collections of curios and some have degenerated to that condition, but the majority are striving in one way or another to test the reactions of the community, in efforts to discover the lines which hold out most hope of stimulating interest. The success or failure of these efforts is a matter of moment to the people as well as to the museums themselves, for upon it depends the place which museums are to take in the life of the community as centres of education and of intellectual and aesthetic pleasure. For many of our local museums, perhaps for most, this place is still undecided, and accordingly advice upon the most promising lines of progress by a museum official of experience and standing ought to fall upon open ears.

At the Newcastle conference of the Museums Association held in July, Dr. W. E. Swinton of the British Museum (Natural History), in a paper which has appeared in the *Museums Journal* (September), gave sound advice upon the improvement of collections. He justly pointed to the hesitancy of many municipalities to give proper financial backing to the museums under their care, a hesitancy to be observed particularly in the appointment of suitably paid curators with knowledge and training for posts which have their own peculiar difficulties and make their own special demands. Thanks to an awakening conscience and to the efforts of the Carnegie United Kingdom Trust, that position is improving, and "many municipal authorities to-day

feel, though vaguely it may be, that a natural history museum is somehow an asset to the community".

Granted a suitable curator, what of the collections themselves? In the first place the local natural history museum should concern itself with the objects of its own neighbourhood, and secondly, it should present these in such a way that the visitor should be induced to take a fresh or increased interest in the local fauna, flora and geology. That implies ruthless elimination of surplus specimens, so that room may be gained for a few well-selected groups in natural habitats, well lit and clearly, instructively and yet simply labelled.

Dr. Swinton properly suggests that no zoological series is complete without the inclusion of fossil forms in their systematic position, presumably to illustrate the course of evolution. But why not take the bull by the horns and arrange selected series specially to illustrate evolution and other general truths, for that would be education at its best; and the ordinary visitor who could visualize evolution from the systematic exhibits of most museums would be a miracle himself. The time will come when systematic collections, except for the merest skeleton of classification and other defined purposes, will be relegated to cabinets where identifications and detailed comparisons can best be made, and galleries will largely be given over to exhibits which stimulate observation of the habits and adaptations of living things, and which lead visitors gently to appreciation of the great truths which lie behind structure and development and evolutionary progress. J. R.

The Palao Biological Station

THE Tropical Biological Station, founded by the Japan Society for the Promotion of Scientific Research, was opened officially in April 1936 with a staff consisting of a director and three researchers drawn from Japanese universities. Its laboratory is situated to the south of Kororu Island in lat. $7^{\circ} 21' N.$, about the middle of the main Palao series. The whole group lies 500 miles east of the Philippines and consists of three or four small atolls to the north, a single elevated limestone island to the south and in the centre a great bank about 80 miles long by 15 miles broad with six main islands and more than two hundred islets. Most of the land is situated to the east with fringing reefs, while a great barrier to the west encloses a long narrow lagoon, which reaches a depth of more than thirty fathoms. Andesite and crystalline limestone form the land, the latter in terraces mainly in the southern half. Historically, the group is interesting for Karl Semper ("Animal Life", 1881), on the evidence collected there, was one of the first of that long series of field workers to dissociate himself from Darwin's theory of universal oceanic subsidence to explain the formation of atolls and barrier reefs.

The laboratory is a frame building with sheds and small boats, and provides accommodation for four research workers, who have to devote their attention to biological studies of coral reefs; their expenses are paid by the Society, and each stays at least four months. It is situated on a bay, or secondary lagoon (Iwayama), almost entirely enclosed by high land, which here forms the meeting place of limestone and andesite. The bay is studded with many elevated limestone islets and has depths up to fifteen fathoms; it lies next to that area where Mikimoto cultures his pearls. Well protected from the trade winds and with small currents, corals grow in great variety, so far 116 species representing 43 genera having been collected. Most are "very delicate and brittle" and "show poor growth" so that the hoped-for comparisons with the vigorous growth of open lagoons and of sea reefs will be difficult. On the other hand, possessing protected environments where corals can be easily planted, the bay should be excellent for the study of the biology and variation of species.

Among the separate reports which follow, Fujio Hiro describes twenty-five cirripedes, leaving their interesting coral commensals to a future paper. He also studied crabs forming galls on corals, these due to the growth of coral around the young crab which has settled upon it. There is little new here beyond what Potts told us, except to show that the cavities produced vary greatly. A hydrographical study by Matsuya discloses in the bay higher temperature and silica and lower chlorinity, oxygen, pH and phosphates than in the ocean waters. Noboru Abe undertook the development of *Fungia* from the planula to the commencement of skeletogenous formation. Fertilization occurs in the gonad at full moon, and the planula there formed is liberated at new moon from September until April. It attaches itself on the third day and the first septa commence to form on the seventh; the growth curve shows a marked and suggestive slowing as soon as the septa commence to form. The development is said to be much delayed by an absence of light; but a deeper study is necessary before many interesting features can be understood. J. S. G.

University Events

BIRMINGHAM.—On October 14 H.R.H. the Duke of Kent, as patron of the Hospitals Contributory Schemes Association, visited Birmingham to attend the annual meeting of the Association. His activities included a visit to the new Hospitals Centre and Medical School, after which at a special degree congregation the Chancellor of the University (Viscount Cecil of Chelwood) conferred on His Royal Highness the degree of LL.D.

With the object of securing closer contact between the University and the two Birmingham municipal hospitals at Dudley Road and Selly Oak, five of the professors of the Medical Faculty of the University have been appointed as part-time consultants to the hospital staffs. The professors are Sir Beckwith Whitehouse, Mr. W. H. Wynn, Mr. Philip Cloake, Mr. William Gemmill and Mr. Seymour Barling. The appointments have been made by the Birmingham Health Committee.

CAMBRIDGE.—G. Metcalfe, of Clare College, has been appointed to the Frank Smart University studentship in botany.

G. S. Gough, of Pembroke College, University lecturer in engineering, has been elected into a fellowship at Trinity College on appointment as lecturer in mechanical sciences. C. H. Bamford has been elected into a fellowship at Trinity College for research in natural sciences. He obtained a 1st Class in Part I, Natural Sciences Tripos (1933) and in Part II (1934), (Chemistry). D. M. A. Loggett has been elected into a fellowship at Trinity College for research in applied mathematics. He obtained a 1st Class in Part I, Mathematical Tripos (1932), and in Part II (1934), Wrangler (b) distinguished; Rayleigh Prize, 1936.

The Council of the Senate has reported that the University will eventually benefit under the will of the late Mr. William Charles Wilson, of St. John's College, to the extent of about £15,000. No conditions are attached. The Council is of the opinion that, in view of Mr. Wilson's interest in the alleviation of human suffering, it would be appropriate to use his bequest for the furtherance of some allied branch of research. It is recommended that the bequest be applied to the provision of an extension of the Psychological Laboratory. Should this recommendation of the Council be approved, the Rockefeller Foundation has promised to give £11,360, spread over a period of five years from January 1, 1938, towards the cost of developing the Department of Experimental Psychology.

SHEFFIELD.—A contribution of £5,000, being the second instalment of the contribution of £10,000 promised by the City Council, has been made to the University Extension Fund.

E. T. Goodwin and T. D. H. Baber have been appointed assistant lecturers in mathematics, and Dr. Helen Mellanby part-time demonstrator for medical and dental students in the Department of Zoology.

The following resignations have been received: Mr. J. W. Frame, of his post of lecturer in mathematics; Mr. J. Jenkins, of his post of lecturer in civil engineering; Dr. E. S. Duthie, of his post of demonstrator in pathology.

Science News a Century Ago

The Aurora Borealis

The Times of October 25, 1837, quoted from the *Leamington Chronicle* the following description of an aurora borealis. "Nearly the whole population of Leamington appeared, with ourselves, wonder-struck, last evening, by the appearance which is seldom witnessed in this locality—viz., the aurora borealis. This gorgeous and most sublime spectacle was visible from 6 until half-past 7 o'clock. The clouds in the north-east appeared as if suffused with the reflection of a vast mass of crimson flame. The stars seen through this brilliant medium had an extraordinary appearance, for the brilliancy seemed to be heightened by the surrounding glory. A gentleman who stood near us on the bridge, and who has resided in countries where the aurora borealis is a frequent visitor, directed our attention to a singular novelty in the effect of this striking atmospherical spectacle as it appeared about half-past 6 o'clock. At that period dense lines and dark clouds in parallel perspective lines spread from the far south-east, narrowing by regular gradations, and converging towards that flood of splendid light which 'pavilioned with its thousand glorious dyes' the whole northern horizon."

Arthur Woolf, 1766-1837

ON October 26, 1837, the famous Cornish engineer, Arthur Woolf, died at The Strand, Guernsey, to which he had retired four years previously. A mechanical engineer of the first rank, whose engines were noted for their fine finish, he was one of the last of the contemporaries of Watt, who made the Boulton and Watt steam pumping engine the admiration of the world. The Hornblowers, Bull, Trevithick, Harvey and others all had a share in the improvement of the Cornish pumping engine, which by about the time of Woolf's death had a 'duty' of more than 100 million ft. lb. per cwt. of fuel as compared with the 30 millions for engines at the beginning of the century. Some of the engines constructed by Woolf himself had cylinders of 90 in. diameter with a 10 ft. stroke, and at one time he had more mining engines under his charge than any other engineer in Cornwall.

Born at Camborne in 1766, Woolf served an apprenticeship as a carpenter, and then moved to London where he was fortunate enough to find employment in the shop of the famous mechanician Joseph Bramah, in Pimlico, having for one of his fellow workmen Henry Maudslay. When nearly thirty years of age he left Bramah to erect some engines for Hornblower, in Durham, and on his return to London secured the post of engineer to Meux's Brewery, having charge of the machinery and apparatus. Here he installed plant for heating water by waste steam, invented a cast-iron tubular boiler and made his first engine in which the steam was expanded successively in a high-pressure and a low-pressure cylinder; an important type of engine to which long afterwards the name of a 'compound' engine was given. At first he placed his cylinders side by side at the end of the overhead beam, but later on placed the high-pressure cylinder nearer the centre of the beam, an arrangement adopted later on by McNaught.

After spending the years 1797-1806 at the Brewery, Woolf joined Humphrey Edwards in partnership as an engine maker in Lambeth. The partnership lasted only five years, when Woolf returned to

Cornwall, where he erected at least six compound pumping engines. By 1824 the single-cylinder, however, had been greatly improved, and it was shown that with the steam pressures then in use—20-30 lb. per sq. in.—there was no advantage in compounding, and it was therefore with the development of the single-cylinder engine that Woolf's last work was done. He was engineer to the important groups of mines known as the Consolidated Mines and United Mines, and was also associated with the Hayle engine works of Harvey. Working in the dark, as they were, as to the theory of heat engines, Woolf and his fellows yet made a great contribution to steam engineering.

John Mackintosh (?-1837)

DR. JOHN MACKINTOSH, an eminent Edinburgh physician, the date of whose birth is not recorded, was born at sea on return of his mother from America, whither she had accompanied his father, Captain Mackintosh, on service. He studied medicine at Edinburgh, where he qualified in 1808, and was then appointed medical officer in the Royal Artillery. After serving in the West Indies, South Africa and France with the army of occupation after the battle of Waterloo, he settled in practice in Edinburgh, where he became physician to the General Brown Square Dispensary and later professor of obstetrics and practical medicine in the School of Medicine and Surgery. In 1822 he published a work entitled "A Treatise on the Disease Termed Puerperal Fever, Illustrated by numerous Cases and Dissections", the disease at that time being very prevalent in Edinburgh and Leith. In the following year he began a course of lectures on midwifery and diseases of women and children, and proved a very successful lecturer. In 1825, in compliance with a request from the Edinburgh students, he delivered a course of lectures on the "Principles of Pathology and Practice of Physic". His chief work, which had the same title, was first published in 1828 and was extremely popular among students and general practitioners both in England and America, so that it went through four editions. He devoted a good deal of his time to the investigation of cholera and made some important additions to the knowledge of its morbid anatomy. His death, which was due to typhoid fever, took place on October 28, 1837.

Subterranean Forest

THE *Gentleman's Magazine* of October 1837 contains an account of the following interesting discovery: "The labourers who are excavating the common sewer in High St., St. Giles, Westminster, lately discovered just opposite the church two elm trees, in a high state of preservation at a depth of about 15 feet under the surface of the ground, lying completely across the part undergoing excavation, and being parallel to each other, though at a distance of several yards. They were obliged to be sawn through, and the pieces which were removed to the surface were each about nine feet long and five in circumference. These trees were supposed to have belonged to a forest which once covered this and the surrounding district. On examination the exhumed timber was found to be as sound as if it had been felled only a few months. The superincumbent strata were composed of common rubble, clay and sand, the whole of which was remarkably dry to the above depth."

Societies and Academies

Paris

Academy of Sciences, August 9 (*C.R.*, 205, 345-380).

RAYMOND HAMET: Demonstration of the direct vaso-constrictive action of a nicotinic substance, cytisine.

Mlle. DIGNA VAN STOLK and ROLAND LEROY DE LENCHERE: Folliculin and dihydrofolliculin in the urine of pregnant mares.

August 23 (*C.R.*, 205, 397-428).

GEORGES CLAUDE: The search for aeroplanes lost at sea. Results of a practical application of the method (use of fluorescein) proposed by the author.

DIMITRI RIABOUCHINSKY: The vortex shaft method of hypersupport.

B. CARRERA: The moments of some cations of the rare earths and Weiss magnetism.

LUCIEN DANIEL: New experiments on acquired heredity in the leek.

ARYEH DVORETZKY: The arguments of the singularities of analytical functions.

LÉOPOLD ESCANDE: Flow through a valve.

PIERRE VERNOTTE: The convection currents in experiments on thermal conduction.

GEORGES FOURETIER: The precipitation of tricalcium phosphate and of hydroxyapatite.

C. F. GOODEVE and F. D. RICHARDSON: The existence of chlorous anhydride. A repetition of the experiment described by Kantzer (*C.R.*, 155, 158) for the preparation of Cl_2O_3 fails to confirm his conclusions: spectroscopic examination showed that only chlorine dioxide is formed.

LÉON CALEMBERT: Contribution to the geological study of the culminating massif of Ouarsenis (Algeria).

HUBERT GARRIGUE: The measurement of the radioactivity of the air enclosed in the snow layer, near the soil, in the mountains.

MAURICE LANGERON: New statistical and mycological observations on human favus in Morocco.

Mme. VERA DANTCHAKOFF: The action of the female sex hormone on reptiles.

August 30 (*C.R.*, 205, 429-452).

PIERRE LEJAY: Measurements of gravity in Normandy and Brittany. Tabulated results for measurements of g at 21 stations in Normandy and Brittany.

ANDRÉ HAARBLEICHER: Curves which are their own isogonal inverse with respect to a triangle.

W. K. TURKIN and P. E. DUBUQUE: Theorems on infinite groups.

PAUL PETRY: The determination of pressures and velocities in breaking waves. Measurements made on waves breaking on a jetty.

MAURICE D'OCAGNE: Remarks on the preceding note, pointing out that this is the first time such measurements have been attempted.

HOZIA HULUSEI: Contribution to the study of the K emission spectrum of gallium (31) and of germanium (32).

RAMI GISSER: The p,p' -dimagnesium compounds of diphenyl. The favourable role of magnesium iodide.

WILLIAM HENRI SCHOFFER: The action of the constituents of aneurin on yeasts (*Rhodotorula rubra* and *R. flava*).

MARCEL AVEL: The experimental study of the morphogenesis of the central nervous system in the regeneration of the head of worms.

Y. RAOUL: The evolution of hordenine in barley and the ultimate relations of this alkaloid with the tyrosine.

Geneva

Society of Physics and Natural History, July 1.

CH. BAEHNI: The male inflorescence of *Scyphostegia borneensis*. Following the discovery of a male specimen of this plant it would appear that the classification of the latter in the family of the Moraceae or in any other family of the nettles is erroneous. The exact systematic position of this plant is at present doubtful.

ALB. PERIER: Some critical observations on the torus mandibularis and on its ultimate phylogenetic signification. A detailed analysis shows that two varieties of mandibular hyperostoses must be considered: (a) the torus mandibularis alveolaris and (b) the torus mandibularis arcuatus. The examination of two series of mandibles, Genevan and Bushman, on which these toriform arrangements are encountered, shows that the torus mandibularis is not specifically Asiatic, as has been supposed hitherto.

P. WENGER, CH. CIMERMAN and A. CORBAZ: The micro-estimation of cobalt by means of anthranilic acid. The authors have established a gravimetric micro-method for the determination of cobalt by means of anthranilic acid.

CH. CIMERMAN and P. WENGER: (1) The micro-separation of zinc by means of *o*-oxyquinoline in acetic solution. (2) The volumetric micro-estimation of zinc in alkaline solution. The authors have established the conditions for the micro-separation of zinc with the cations NH_4 , K, Na, Li, Mg, as well as a micro-estimation of zinc in alkaline solution.

E. BRINER and E. PERROTET: Complementary results on the catalytic action of ozone in the oxidation of aldehydes. The influence of the peroxide present. This catalytic action is shown by an increase in the absorption velocity of the oxygen; the presence of peracids increases this velocity as measured by the bubbling method.

D. MONNIER, B. SUSZ and E. BRINER: The Raman spectra of acrylic acid and of methyl methacrylate, both monomer and polymerized. The disappearance of the frequencies of the vinyl group in the polymer shows that the latter is a substance no longer containing the double bonds of the monomer.

L. MISCH and VAN DER WYK: The structure of crystallized azulene. Interference analysis with X-rays of azulene has furnished a whole series of crystallographic constants, which from this point of view suggests that this substance is allied to naphthalene.

EUG. PITTARD and HAYRI AZIZ SEYLAN: Prognathism, cranial capacity and area of the occipital perforation in the anthropoids. The authors have studied various skulls of gorillas, orang utans, chimpanzees, and gibbons. It follows from this work that the construction of the cranio-facial edifice is somewhat different in the anthropoids, according to the genus under examination.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, October 25

UNIVERSITY OF LEEDS, at 5.15.—Dr. F. Simon: "The Temperature Region below 1° Absolute".*

REDSON CLUB, KING'S COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Prof. G. I. Finch: "Electron Diffraction and Surface Structure" (Redson Lecture).

Wednesday, October 27

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Prof. Raymond Pearl: "The Natural History of Population" (succeeding lectures on October 28, November 1, 3 and 4).*

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at King's College, Strand, W.C.2), at 8.—Dr. A. F. Titley: "Paracelsus: A Résumé of Some Controversies".*

Thursday, October 28

CHEMICAL SOCIETY, at 5.30.—Prof. C. H. Desch, F.R.S.: Le Chatelier Memorial Lecture.

Friday, October 29

GEOGRAPHICAL DISCUSSION (at the Royal Astronomical Society), at 4.30.—"Variation of Latitude" (Opener: Dr. Spencer Jones, F.R.S.).

ROYAL SOCIETY OF MEDICINE, at 9.15.—Philip Guedalla: "The Method of Biography" (Lloyd Roberts Lecture).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER IN MATERIA MEDICA AND PHARMACOLOGY in the Welsh National School of Medicine, The Parade, Cardiff—Secretary (October 25).

HEAD OF THE CHEMISTRY DEPARTMENT of the Northampton Polytechnic, St. John Street, London, E.C.1—Principal (October 31).

HEAD OF THE CHEMISTRY DEPARTMENT of the Burnley Municipal College—Director of Education, Education Offices, Burnley (November 8).

PRINCIPAL of the St. Helens Municipal Technical School—Director of Education, Education Office, St. Helens (November 6).

ASSISTANT IN THE DEPARTMENT OF NATURAL HISTORY in University College, Dundee—The Secretary.

Official Publications Received

Great Britain and Ireland

Miscellaneous Publications of the International Tin Research and Development Council. No. 6: The Role of Technical Information in Industrial Research and Development. By Dr. C. E. Homer and Dr. E. S. Hodges. Pp. 9. (London: International Tin Research and Development Council.) Free. [710]

Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1937. Pp. 24+4 plates. (Kirkhill: Hannah Dairy Research Institute.) [510]

Bacon Development Board. Bulletin No. 2: Substitutes for Cereals in Pig Keeping. Pp. 62. (London: Bacon Development Board.) 2s. [910]

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1699: Report on Puss Moth Accidents, complete with Appendices. Pp. 388+19 plates. (London: H.M. Stationery Office.) 80s. net. [910]

The English Golf Union Year Book, 1937. Pp. xii+196+46. (Northwood: Rawlinsons Library.) 2s. 6d. [910]

Management Library. Progress Report for the Five Years ended 30.6.37. Pp. 4. (London: Management Library.) [910]

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 26th October 1937. Pp. 44. (Newcastle-upon-Tyne: Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne.) [1110]

Transactions of the Royal Society of Edinburgh, Vol. 59, Part 1, No. 7: The Middle Devonian Fish Fauna of Achanarras. By C. Forster-Cooper. Pp. 223-240+8 plates. 5s. Vol. 59, Part 1, No. 8: On a New Longheaded Dipnoan Fish from the Upper Devonian of Seamenac Bay, P.Q., Canada. By W. Graham-Smith and Dr. T. B. Westell. Pp. 241-266+2 plates. 4s. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1110]

Proceedings of the Royal Society of Edinburgh, Session 1936-1937. Vol. 57, Part 3, No. 21: On the Immature Stages of some Scottish and other Psyllids. By Dr. K. B. Lal. Pp. 305-331. 2s. 8d. Vol. 57, Part 3, No. 22: Some Distributions associated with a Randomly Arranged Set of Numbers. By Dr. W. O. Kermack and Lieut.-Col. A. G. McKendrick. Pp. 332-376. 4s. Vol. 57, Part 3, No. 23: On Rotating Mirrors at High Speed. By Sir Charles V. Boys. Pp. 377-378. 6d. Vol. 57, Part 3, No. 24: Geonometries Dendyi Dakin, a Land Nemertean in Wales. By A. R. Waterston and H. E. Quick. Pp. 379-384. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1110]

Society for the Promotion of Nature Reserves. Handbook, 1937. Pp. 44. (London: Society for the Promotion of Nature Reserves.) [1110]

Other Countries

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Meteorological Observatories, Bombay and Alibag, in the Year 1936, under the direction of Dr. S. C. Roy. Reduced and tabulated under the direction of Dr. S. C. Roy and Dr. K. B. Ramanathan. Pp. xiv+A74+B41+C2+D15. (Delhi: Manager of Publications.) 0.14 rupees; 16s. 6d. [410]

Report of the Forest Department, British Honduras, for the Year 1936. Pp. 19. (Belize: Forest Department.) [510]

University of Illinois: Engineering Experiment Station. Circular No. 28: An Investigation of Student Study Lighting. By Prof. John O. Kruehenbuehl. Pp. 36. 40 cents. Circular No. 29: Problems in Building Illumination. By Prof. John O. Kruehenbuehl. Pp. 28. 35 cents. Circular No. 30: Papers presented at the Twenty-fourth Annual Conference on Highway Engineering held at the University of Illinois, March 3-6, 1937. Pp. 154. 50 cents. Reprint No. 11: Third Progress Report on the Joint Investigation of Fractures in Railroad Rails. Pp. 30. 15 cents. (Urbana, Ill.: University of Illinois.) [510]

U.S. Department of Agriculture. Circular No. 390: Flour-Mill Insects and their Control. By G. A. Dean, E. T. Cotton and G. H. Wagner. Revised edition. Pp. 40. 5 cents. Miscellaneous Publication No. 271: A Revision of the Leafhoppers of the Macrosteles Group (Cicadula of Authors) in America North of Mexico. By H. S. Dorn. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office.) [510]

Smithsonian Miscellaneous Collections. Vol. 98, No. 5: The Male Genitalia of Orthopteroid Insects. By R. E. Snodgrass. (Publication 3442.) Pp. 107. (Washington, D.C.: Smithsonian Institution.) [710]

League of Nations: Health Organisation. Report of the Inter-governmental Conference of Far-Eastern Countries on Rural Hygiene, held at Bandoeng (Java), August 3rd to 13th, 1937. (Official No.: A.19.1937.III.) Pp. 120. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2s. 6d. [710]

Brooklyn Botanic Garden Record. Vol. 26, No. 4: Prospectus of Courses, Lectures and other Educational Advantages offered to Members and to the General Public, 1937-1938. Pp. iv+85-876. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [810]

Kenya Colony and Protectorate: Department of Agriculture. Annual Report, 1936. Part 2. Pp. ii+102. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 2s. 6d. [910]

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 6, No. 19: The Orbit of the Eclipsing Binary Ar Aurigae. By W. E. Harper. Pp. 311-316. (Victoria: Dominion Astrophysical Observatory.) [1110]

In Memoriam, Joh. Ev. Purkyně, 1787-1937. Pp. iv+102. (Prague: Purkyněova Společnost.) [1110]

Proceedings of the Conference on Maternity and Child Welfare, 12th to 13th December 1936, Madras. Pp. vii+165+xiii. (Madras, Madras: Health Propaganda Board.) 6 annas. [1110]

Department of Agriculture: New South Wales. Science Bulletin No. 66: Plant Breeding in New South Wales; Tenth Year of Progress, 1935-36. Pp. 64. (Sydney: Government Printer.) [1110]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 108: The Basaltic Soils of Northern Tasmania. By U. G. Stephens. Pp. 40. Bulletin No. 109: The Variability of Plant Density in Fields of Wheat and its Effect on Yield. By H. Fairfield Smith. Pp. 28. (Melbourne: Government Printer.) [1110]

Oil Production from Coal viewed from an Australian Standpoint. Report by Sir David Rivett. Pp. 23. 1s. Oil from Coal: Second Report of the Committee appointed to inquire into the Question of establishing a Plant in Australia for the Production of Oil from Coal by the Hydrogenation Process. Pp. 6. 6d. (Canberra: Commonwealth Government Printer.) [1110]

Summary Proceedings of the Thirty-fourth Meeting of the Indian Central Cotton Committee, Bombay, held on the 2nd and 3rd March 1937. Pp. 64. (Bombay: Indian Central Cotton Committee.) 1 rupee. [1110]

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Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LEEQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3548

SATURDAY, OCTOBER 30, 1937

Vol. 140

A Scientific Approach to the Colonial Problem

THE Prime Minister has consented to receive a deputation on Monday next in support of a petition urging that the Government should take the initiative in promoting an inquiry into the fundamental causes of rivalry and unrest among the nations, by inviting all other fully self-governing States or Dominions to combine in setting up expert commissions to ascertain and report upon the basic facts in regard to such questions as access to raw materials and world markets, colonial development and the problem of surplus populations, etc. This proposal for fact-finding commissions is, of course, no novel idea ; but the influential support which the petition has received indicates how rapidly the idea is gaining ground.

Already an inquiry into raw materials has been initiated by the League of Nations with the support of Great Britain, and the League Committee on Raw Materials has now completed its report. This inquiry is a direct outcome of an offer made by the British Government in 1935 and formally renewed in 1936. Even earlier, however, valuable work of this kind had been carried out in respect of problems concerned with the Pacific by the Institute of Pacific Relations, and the scientific study of similar problems affecting European relations was considered by a Conference for the Scientific Study of International Relations held at Copenhagen in June 1931.

While, however, the idea of impartial inquiry into the basic facts as a preliminary to concerted action designed to eliminate causes of friction is steadily gaining ground in public opinion, a good deal of valuable investigation is being quietly carried out by different organizations, the results of which have been published. Reference has

been made above to the work of the Institute of Pacific Relations ; and the situation in the Far East is the more regrettable because of the admirable work of the Kyoto and later Conferences.

In Great Britain the Royal Institute of International Affairs has already issued a number of valuable studies and reports such as "Raw Materials and Colonies" and "The Colonial Problem", which are only the latest and most detailed of them. In addition, other organizations are doing invaluable educational work, such as the New Commonwealth Institute, by means of its Information Bulletins, on questions of peaceful change and collective security, which not only prepare a wider circle of the public to accept the idea of the impartial investigation of such matters generally, but also assist materially in the formation of intelligent public opinion upon particular questions.

The League Committee for the Study of the Problem of Raw Materials has held three sessions, and the two sub-committees appointed to study the supply of raw materials and difficulties of purchase and payment have completed reports which are embodied in the final report. On the question of supply, the report indicates that while prohibition and restriction of raw materials might be justified as defensive measures, there are serious objections to their use for exercising pressure on other countries, for the preservation of uneconomic industries or for the maintenance of artificial price levels. It recommends accordingly that these obstacles should be removed as soon as possible and that nations should enter into agreements not to employ them. Similarly the Committee takes the view that

countries controlling important quantities of raw materials should not place unreasonable obstacles in the way of those wishing to exploit these resources, and that their legislation should take account of the interdependence of nations as the basis of general welfare.

In common discussions this question of access to raw materials has been closely linked with the colonial question, and the League Committee's report indicates that some modification of the privileged situation which nationals of the mother country in fact enjoy in most colonial territories is desirable. Actual monopolies are rare, but the report clearly indicates the need for further investigation and study. Similarly the sub-committee dealing with obstacles to payment makes various suggestions for reducing existing restrictions on imports and exports by bilateral or multilateral action.

The League Committee's report includes, accordingly, a suggestion to re-examine the International Convention of 1927 for the Abolition of Import and Export Restrictions and Prohibitions, which should implement the resolution recently passed by the International Chamber of Commerce asserting that all countries should, so far as possible, have access to essential foodstuffs and raw materials. Much room is, however, still left for further investigation and discussion before an adequate and generally acceptable solution of the whole problem can be achieved. The appearance in the meantime of the latest report of the Institute of International Affairs* on the colonial problem is therefore particularly welcome. If its presentation is not all that could be desired—much of the third part, "Investment, Trade and Settlement", could with advantage have been dealt with earlier or incorporated in the appendixes, and the first part, "The International Aspect", should properly have followed the second, "The Colonial Aspect"—it contains much information to clarify thought upon many of the proposals at present being debated, such as the extensions of the 'open-door' policy in colonial territories or the transfer of colonies into Mandated Territories or territories under international administration. The most valuable and significant part of the book is, in fact, the second part, in which the colonial aspect of the problem is considered, and especially the chapters in which the theory and practice of the present status of colonies are reviewed and the

importance of common principles of administration is stressed. The vast amount of exact information which it contains is, of course, the chief value of the book, but the task of sifting and selection cannot be pursued without judgment on the main issues. Particularly in this section of the report, the directions in which further inquiry is still called for are clearly indicated.

The dominant impression left on the mind by the survey presented in this part of the book is the immense field for co-operation and investigation which the colonial problem presents. It is seen not merely as a matter of immediate controversy, but rather as a constant problem the cure of which lies in the relations between economic and political aspects. The searching analysis which the study group gives of the way in which the democratic countries themselves are living up to the standards they profess shows no tendency to insist on the merits of British administration as opposed to those of other colonial Powers. In such questions as populations, the relative merits of plantations and native farming, labour policy, health services, education and nutrition, the report indicates the real problems to be faced and the need for research in British territories as elsewhere.

No scientific worker can read these chapters without realizing how large a contribution science itself has to make in providing a solution to these problems and assisting in the foundation of a wise policy. The possibilities for human happiness thus indicated make the present international clamour seem as stupid as it is threatening. Common principles of administration are essential because each of the colonial Powers is subjected to the same sort of criticism, whether from within or from without. Each suffers from the other's mistakes. The universal adoption of certain basic principles of justice towards non-colonial Powers and towards subject races is dictated by common prudence as well as by the more generous ideals of progressive civilization.

The colonial Powers must, in fact, prove to other Powers that their policy is not to exercise monopoly rights for themselves but rather to administer colonial resources in the general interest; and they must also prove to peoples in the Colonies that the protection and the administration they offer is a fair return for the taxation and the other obligations they impose, and is directed to ensure local prosperity. The report, indeed, suggests that in its international aspect the colonial problem is more than a grievance of particular "dissatisfied"

* The Colonial Problem. A Report by a Study Group of Members of the Royal Institute of International Affairs. Pp. xiii+448. (London, New York and Toronto: Oxford University Press, 1937). 21s. net.

nations against particular "satiated" nations: it is a grievance of the whole community of nations against the misuse, wherever it occurs, of colonial sovereignty. All departures from the principle of the 'open door' are an injustice to the international community.

The adoption of common principles of administration would facilitate transfer, but the division of Europe into democratic and authoritarian States complicates the issue greatly. Transference of mandates or colonial sovereignty to States repudiating the League Covenant, and with it the international machinery set up to promote international co-operation and to ensure common standards in the administration of subject peoples, would be an even greater injustice to the international community. There is, in fact, little in the report to hold out hope of meeting the needs of non-colonial Powers in terms of prestige and world power.

Though the difficulties in the way of transfer are clearly displayed, a number of concrete suggestions for meeting the needs of the non-colonial Powers by methods that do not involve transfer are indicated for securing equality of economic opportunity. Moreover, the facts in regard to access to raw materials are set forth in a way which scarcely upholds many of the contentions of the non-colonial Powers. If, for the moment, it is assumed that the correct view of the problem is how to make available the raw materials of industry, the report very effectively disposes of some of these illusions. Of the basic raw materials as defined by Dr. Goebbels himself, France, the United States and Russia produce between them 66 per cent of the world's iron ore; the United States and the United Kingdom 54 per cent of the world's coal; the United States, Russia and Venezuela 81 per cent of the world's oil; the United States, India and China 75 per cent of the world's cotton; Chile, the United States and Canada 49 per cent of the world's copper; and Malaya and the Dutch East Indies produce 83 per cent of the world's rubber.

Accordingly, the basic raw materials, with the exception of rubber, are produced mainly within the boundaries of sovereign States. Rubber alone is mainly a colonial product, but this raw material is open to purchase by all comers on equal terms, and there is no reason why foreign capital should not acquire rubber estates. Equal access is indeed given in enormous colonial areas, although considerable restrictions do exist upon free trade in

colonial areas not covered by special treaties. An international agreement to guarantee equal commercial access over a much wider area, in accordance with a former principle of British colonial administration, should therefore do something to remove the feeling of non-colonial Powers that they may be cut off at any moment from access to all colonial supplies.

The problem of access to raw materials, therefore, is not the core of the colonial problem. The present study makes it clear that there is no simple solution and that the matter is one calling for the closest and most careful study. No hasty decisions are likely to be an easy way out of a dynamic but constant problem. The position of the colonial Powers is difficult. Mere transfer of colonial territories to the threatening States would not purchase safety and would be treachery to the colonial peoples and to the world community. The exposition of the facts given by the study group of the Royal Institute of International Affairs reinforces the need for some effective international organization and authority, such as the League of Nations, to which all colonial territories could ultimately be surrendered for administration under trust for the world community. Until that organization and authority are effectively established, the colonial Powers must perforce live dangerously, and their danger is best mitigated if their sovereignty is exercised in trust, first on behalf of the peoples inhabiting these areas and secondly for the wealth of all nations. In their own interests alone they must extirpate all taint of monopoly and exploitation.

Such a policy is not one of mere negation to the demands and aspirations of the dissatisfied or non-colonial Powers. It is essentially one of peaceful change, which offers the maximum inducement to participation in a system of international co-operation and collective security. Only as the facts are impartially assembled, and lucidly presented and clearly understood, can we hope to win acceptance of such ideas or policy, and the greatest merit of this volume is the weighty contribution it offers to the education of public opinion, in Great Britain no less than in other countries. Nor should it be forgotten there will still remain the task of organizing public opinion effectively everywhere to compel action in accordance with the facts, and to resist those nations who wantonly disregard them to the detriment of the community of nations.

World Structure

Relativity Theory of Protons and Electrons

By Sir Arthur Eddington. Pp. viii + 336. (Cambridge: At the University Press, 1936.) 21s. net.

DURING the past ten years or a little more, physicists have found themselves more and more peremptorily confronted with a question of theoretical conscience—a question which has gradually and almost inadvertently become of overwhelming weight. It is that of how to reconcile Relativity Theory and Quantum Theory. Increasing uneasiness grew from the fact that in the course of their development, *both* theories approached what many regarded as final states of perfection, but without reaching true *Anschluss* to one another, or even reconciling their mutual discrepancies. Having, both of them, acquired the rank of inalienable knowledge, they seemed incapable of undergoing serious modifications, yet in urgent need of such, in view of the mutual inconsistency of their respective fundamentals. The book under review, which is an enlarged exposition of the author's investigations from 1928 until 1936, in a way is a continuation of his well-known book on relativity. The least that must be said in praise of the present work is that Sir Arthur puts forward sufficient evidence of *blunder* (in the sense of misapprehension, of course) in current quantum- or wave-mechanics to reassure us that, in this theory, there is room and indeed need, for radical readjustment.

The General Theory of Relativity deals with macroscopic space, time and matter, which it treats as continua, admittedly ignoring the particle-structure. Space and time were formerly regarded as the mere frame, scene or stage on which or in which physical events take place. The content of the frame or the actor on the stage was called *matter*. Relativity Theory established such an intimate connexion or rather amalgamation between matter and space-time, that the conceptual separation into a pre-existing continuum and what is contained in it is no longer applicable. Space is extended or unfolded by the very matter it contains, and the rolling on of time is essentially determined by its presence. Though *actio in distans* is definitely excluded, yet the most primitive circumstances of an observation made now and here turn out to be the complicated product of all that has been going on hitherto in the rest of the world.

Quantum Theory, in its turn, has emerged from the careful consideration of observations on the detailed behaviour of the matter surrounding us

on our globe and in our epoch—which from the cosmical outlook means in the immediate neighbourhood of a *point* in space-time. By challenging a new meaning for the older ideas of atoms, electrons, radiation, etc., this theory has succeeded in accounting for bewilderingly numerous and complicated facts from comparatively simple (though strange) first principles. It is not very astonishing that in following up these tasks, quantum-physicists deemed it permissible for their purpose to accept as a given thing, which on that occasion called for no further scrutiny, the most primitive condition of the events they investigated, namely, that they happen in space and time; the more so since a rough estimate by Einstein's theory shows that not only the mutual gravitation between the particles composing an atom or a crystal, but also even the modifying influence of a particle on space and time in the *immediate* neighbourhood of the particle is altogether negligible. We were content to pay to Relativity the tribute of conformation to its small-scale geometrical principle, that is, to make everything invariant to the Lorentz transformation (unduly stretching the principle in some cases, as Eddington appropriately points out). But what was neglected was the following. The plane and apparently simple condition of *unmodified* space and time, under which every single particle is observed, is created by the previous and present existence of all the other particles in the world. This fact constitutes an interrelatedness between all of them which makes it imperative to treat previously, in broad outline at least, the problem of the universe, in order to obtain the right outlook for dealing with what is usually, but not very appropriately, called one or a few *isolated* particles.

Having reached this conclusion, we can make two gratifying and promising remarks. First, that quantum theory of its own right is entitled and even compelled to raise the imperative demand of dealing previously with the universe. Secondly, that relativity theory, by its very tendency to ignore the detailed structure of matter and to roam farther and farther to the outskirts of the universe, has quite unexpectedly provided the only sound means for explaining *atomicity*.

To elucidate the first statement: quantum mechanics has to abandon the idea of individuality in different particles of the same kind, two electrons for example. When, let us say, a carbon atom is excited, one of its six electrons is removed to a greater distance from the nucleus; but it is not

quite correct to think of an individual electron occupying the special position, the other five forming the inner core. At any rate, if one indulges in that way of viewing the subject, one has to put up with inadvertent *exchanges* between the electron under consideration and one of the others. Now there is nothing, in principle, to preclude the exchange of a particular electron we are contemplating with *any* other electron existing in the world. Hence if we have excluded some of them, or even most of them, from our investigation, we are quite likely to find ourselves all at once contemplating—nothing. This makes it fairly clear that one has to start by investigating the universe as a whole and to derive the methods, if any, for dealing with small isolated systems from the former investigation.

As regards the second remark: it is by discovering the *finiteness of space* that Relativity Theory has inadvertently found the clue to atomicity. The argument runs as follows. Atomicity is merely the oldest, best-known and still most important expression of the inherent *discontinuities* in Nature. Generally speaking, the latter are accounted for in wave- or quantum-mechanics by means of a close analogy with the discontinuous sets of proper modes of vibrating systems. But artificial devices have to be introduced for that purpose, because only a finite system possesses discontinuous proper modes. So the theorist has to segregate a finite portion of matter, keeping it together by strong forces or enclosing it in a 'box', in order to show atomicity appearing in the segregated region. If the universe were infinite it would be hard to explain along these lines why it is constituted of discrete particles, because its proper vibrations would form a continuous sequence. But Einstein's finite universe is in itself the natural and wall-less box, which engenders atomicity by the necessary discreteness of its proper modes of vibration.

All these different considerations converge to state Sir Arthur's main problem, as I see it, in broad lines thus: treat Einstein's closed universe along the lines of wave-mechanics, as you would treat a gas contained in a vessel, and try to make clear at the same time (1) the observed macroscopic features of the universe, (2) its being composed of particles, and (3) why current quantum-mechanics, dealing with isolated systems in the way it does, is able to account for such a vast multitude of facts (in other words, to regularize the customary procedure of quantum-theorists).

For the benefit of physicist readers, let me give a few details. The actual world is tentatively considered to be sufficiently near *that* state for which the name of Einstein universe, properly speaking, is usually reserved, which really is the only

static (though unstable!) state that is at all thinkable. It is therefore suggestive to identify it, from the point of view of quantum-mechanics, with the *ground state* of the system (the 'normal' or 'unexcited' state, in the case of an atom). Moreover, as in the case of the atom, the Pauli exclusion principle is admitted for the universe, stating that every energy-level (= proper mode) cannot be occupied by more than *one* particle. This really is the most important step. By it the ground state consists in the N lowest successive energy-levels being occupied each by one particle, whereas all the higher levels are vacant (a so-called completely degenerate Fermi distribution). Rigorously fulfilled, that would correspond to the absolute zero of temperature and make the system completely inert. The *actual* state is assumed to be one of slight excitation, very near to the ground state, with just a slight stirring up of the particles at the limit or threshold between the close-packed Fermi distribution below and the ordinarily vacant levels above. (From the point of view of wave-mechanics the levels are the proper vibrations of entire space. They are pictured as three-dimensional spherical harmonics, which by their nodal surfaces subdivide space into compartments of decreasing size. With the lowest mode entire space forms one compartment only. At the limit the compartments turn out to be about the size of a pint.)

It is, of course, the stirred-up threshold region between ordinarily occupied and ordinarily vacant levels which gives rise to the observable events (as in the atom the radiation is produced by the stirred-up light-electron). The particles *we handle* have emerged from this region and must, therefore, possess a certain minimum of energy—that of the threshold level—which is obviously their *proper energy*, m_0c^2 , embodied in their rest-mass m_0 . (My account cannot avoid being *very* rough—as though there were only *one* sort of particles in the world!) On the other hand, the totality of occupied levels (= vibrating modes) constitutes the mass of the universe and determines its radius R —by a well-known formula of General Relativity.

This enables one to *calculate* the radius R of space and the total amount of matter (or number N of particles) it contains from such physical constants only as can be determined within the walls of a room without windows. The results are in excellent agreement with astronomical evidence from, mainly, the recession of extragalactic nebulae—thereby corroborating the opinion that the conditions prevailing in our laboratory experiments are *essentially* determined by the state of the universe as a whole.

The particles well below the threshold have, each of them, an energy *smaller* than the observed

rest-energy m_0c^2 . The *energy-defect* (as it were) corresponds, in the author's opinion, to what in Newton's theory appeared as the *negative potential energy* of gravitating matter. Again, the entire lot of sub-threshold particles or levels supersede the cumbersome lot which in Dirac's famous 'hole'-theory of the positron appeared as an infinite continuous sequence of ordinarily occupied levels of negative energy; and there is the great advantage over the latter that (1) the sub-threshold levels form a *discontinuous* lot, as particles ought to, (2) they are numerous (of the order of 10^{23}) but not infinite in number, (3) they constitute the bulk of the material of the world, whereas Dirac's

lot were mere dummies, place-keepers, doomed otherwise to inactivity.

I have to refrain from following up many other ideas, however interesting they may be. I should be astonished if they proved all tenable in the form given, and so would Sir Arthur be, I believe. We have here before us a sketch of unusual grandeur, of which not the details alone need further development and, maybe, much modification. I am convinced that, for a long time to come, the most important research in physical theory will follow closely the lines of thought inaugurated by Sir Arthur Eddington.

F. SCHRÖDINGER.

The European Snake Venoms

Die europäischen und mediterranen Ottern und ihre Gifte:

Grundlagen zur Darstellung eines wirksamen Schlangenserums. Von Prof. Dr. Richard Bieling, Dr. Albert Demnitz, Dr. Otto Schaumann, Prof. Dr. Hans Schlossberger, Dr. Waldemar v. Schuckmann, Dr. Ernst Schwarz. (Behringwerk-Mitteilungen, begründet von E. v. Behring, Heft 7.) Pp. x + 362 (35 plates.) (Marburg-Lahn: Selbstverlag der Behringwerke, 1936.) n.p.

THE idea for this work originated with Dr. Richard Bieling, head of the Serological Department of the German Dye Trust at the Behring Works, Marburg, and it is due to this organization and its financial assistance that it has been possible to carry it through. The work was commenced in 1931 in an endeavour to find a better and more reliable antivenine for the European vipers in general.

The volume is divided into five parts, and each one is provided with a complete bibliography of its own.

Part 1, by Dr. Schlossberger, is an excellent and careful review of the history of snake venoms in general, and of the methods adopted through the ages for combating it. Part 2 discusses the pharmacology and chemistry of snake venoms and snake sera, and reviews the different groups, neurotoxic, hæmolytic, etc., into which the snake venoms can be divided. Part 3, by Dr. von Schuckmann, deals with the ecology of the European vipers, the methods of keeping and transporting them, a brief account of the venom apparatus, the moulting processes, hibernation, the treatment of disease, and finally the technique of extracting and preparing the venom for use in the making of antivenine. Part 4, by Drs. Schlossberger, Bieling and Demnitz, discusses the

question of antivenine in general and the manufacture of an antivenine for the European vipers in particular. This is the most important part of the book, and it contains much information that is both new and interesting.

The venoms of all the common species of European vipers were examined and their actions observed by experiments on mice. It was found that, not only did the venom of each species and subspecies differ as regards its properties and action, but also that the venom of the same species might vary when taken from specimens obtained in different localities. As was to be expected, the venoms of the majority of the European vipers were hæmolytic and coagulant in their action, but *V. berus bosniensis* and, to a lesser extent, *V. a. ammodytes* and *V. u. ursini* differed in having high neurotoxic properties.

In addition, the antivenines marketed by the different institutions throughout the world were obtained, and their efficacy tested against the venoms of the well-known poisonous snakes, both colubrine and viperine. The results obtained from all the experiments are graphically summed up in a series of charts.

Dr. Schwarz concludes the work with a review of the systematic position of the European members of the genus. Four species are recognized, each with their several subspecies. They fall naturally into two groups, *V. berus*, *V. ammodytes*, and *V. ursini*, the true European species, in one section, *V. lebetina*, an entrant into Europe from Asia, in the other. Their evolution is discussed, the distribution of each form is given and is shown on a large-scale map, and the means by which dispersal was effected is suggested. This part of the work is lavishly illustrated with plates. Each form is figured at least once, and the colour-plates are excellent.

M. A. S.

Progress of Biochemistry

Annual Review of Biochemistry

Edited by James Murray Luck. Vol. 6. Pp. ix + 708. (Stanford University P.O., Calif.: Annual Review of Biochemistry, Ltd.; London: H. K. Lewis and Co., Ltd., 1937.) 5 dollars.

DR. J. M. LUCK and his associates produced the "Annual Review of Biochemistry" for 1937 in ample time for the commencement of the new academic term, when research workers and advanced students, refreshed by their vacation, are eager to achieve new conquests in this field. The present rate of progress is amazing—10,000 papers were abstracted in the previous year—though it is quality alone which matters and one could wish for an etiquette among workers which forbade publication until substantial achievement could be reported. Unfortunately, to-day in the hustle for priority the reverse happens and far too much immature work is published.

We find the quality of the reviews themselves to be improving; they enable the reader to take a definite point of view instead of being a mere recital of results.

With so much available for comment, the reviewer is embarrassed in his choice. First mention may, perhaps, be made of two articles of a timely nature—a sound policy of the editor. One of these deals with the biochemistry of fish: the other with the application of microchemistry to biochemical analysis, entrusted to C. M. McKay of Ithaca, N.Y., and P. L. Kirk of Berkeley, California, respectively.

Fish have hitherto been rather neglected by the chemist, but their culture on the large scale for culinary and stream-stocking purposes has made it more easy to experiment with them—in the United States there are seven hundred fish hatcheries. There is a great species difference among fish, and the trout, most widely studied, conduct their life processes at very low temperatures. A systematic study of growth and physiological problems connected with fish is now under way, and with so much material available and experimentation relatively easy, very definite results may be expected to accrue.

Every major problem of the chemist has been furthered by the use of micromethods: in fact without such the science to-day would be nothing like so far advanced. The name of Fritz Pregl of Graz, who started the development, must stand high on the roll of honour.

In all, the volume contains 28 reviews by 35 authors, the subjects being classified as is now customary. There is a certain amount of overlapping or duplication with substances which come under two headings, but this is all to the good at the present time. An example is afforded by the co-ferments now described as phosphopyridine nucleotides, the nature of which has been at last worked out—their discovery by Sir Arthur Harden thirty odd years ago in connexion with cell-free fermentation aroused a lot of interest. They consist of a pyridine derivative, namely, nicotine acid amide, adenine, two molecules of a sugar, ribose, together with two or three molecules of phosphoric acid, according to their origin. Warburg and a number of other workers have been active in this field.

An attractive review by R. Schoenheimer and E. A. Evans of Columbia treats the chemistry of the steroids, a new term proposed for compounds related to cholesterol to include the sterols proper, the bile acids, cardiac aglycones, toad poisons, saponins, and sex hormones; these form as diverse and remarkable a group of natural substances as can well be imagined, and it is a great achievement largely to have cleared up their problems. Progress has been rapid this last three years since the revision of the old formulæ; the group is uniquely characterized by dehydrogenation with selenium to aromatic hydrocarbons in which the original cyclic carbon skeleton is intact.

Another biochemical field which is assuming increasing importance is that of sulphur compounds, reviewed by V. du Vigneaud and H. M. Dyer of Washington. Biological material has now yielded glutathione, methionine, ergothionine, vitamin B, djenkolic acid, asterubin and heparin, to which must be added a new adrenal compound, $C_4H_{10}O_3S$, the constitution of which has been confirmed by synthesis. Much interest attaches also to the chemical behaviour of the sulphur of proteins.

It would be easy to extract examples of marked progress from every review but space restricts us to final mention of the carotenoid pigments, of which a considerable number of new ones have been isolated from land and water plants largely as the result of the ease of isolation, purification and identification which the newer methods of adsorption, absorption and microchemical analysis have brought. There can be no active biochemist who can afford not to keep this book on his desk.

E. F. A.

The Right Hon. Lord Rutherford of Nelson, O.M., F.R.S.

ERNEST RUTHERFORD was born in New Zealand on August 30, 1871, and he was well educated at schools in Brightwater and Nelson, where his headmaster was the famous cricketer W. J. Ford, formerly a classical master at Marlborough. Rutherford went with a scholarship to Canterbury College, Christchurch, where he quickly made his mark by carrying out an interesting and important research with a magnetic detector of wireless waves. There is a striking similarity between Rutherford's work and that of the famous American physicist, Henry. Both used an aerial, a coil of many turns round a bundle of fine sewing needles and a small magnet which was deflected by the changed magnetism of the needles due to the current in the aerial produced by the wireless waves. Henry, however, detected lightning flashes up to ten miles' distance; Rutherford the sparks from an induction coil, two miles away. I once asked Rutherford if he had then already heard of Henry's work, and he replied, "No"! The two minds converged independently. The genius of Marconi afterwards developed an important magnetic detector which, before the age of valves, was in common use for wireless detection in ships.

The Commissioners of the 1851 Exhibition made a good choice when they elected Rutherford as a scholar. Indeed, has any money ever been better invested? This award enabled Rutherford to go to the Cavendish Laboratory at Cambridge, where Sir J. J. Thomson was conducting his own famous researches and guiding the first great group in England of young physicists, including such men as C. T. R. Wilson, Townsend, H. A. Wilson and Rutherford.

It was at that time a novelty for a young physicist to arrive at the Cavendish from near the antipodes, and there was a slight tendency to ridicule. However, formidable questions from the new arrival were received with some awe, and the rumour soon spread that there was "a young rabbit come from New Zealand, who burrows very deep".

The Cavendish group were at this time measuring the properties of electrons and ions, and in particular there was an interesting method of Rutherford's whereby ultra-violet light shining on a metal plate released electrons, which were made to leap up and down in cycloidal paths by a controlled intensity of alternating potential.

In the meantime the first research professor, the brilliant Hugh L. Callendar, had left McGill for the Imperial College and so the director of the

Macdonald Physics Laboratory, John Cox, visited England (1898) and was so wise and so fortunate as to secure Rutherford as successor to Callendar.

Rutherford even then had a very intimate knowledge of ions, whether produced by ultra-violet light or X-rays. In fact he once remarked, "Ions are such jolly little beggars, you can almost see them." He was therefore able to pursue with swiftness and accuracy his investigation of the radiations from radioactive substances which had been discovered by the genius of Becquerel, Pierre and Marie Curie, and others. Moreover, Sir William Macdonald presented his laboratory with a liquid-air machine, and three hundred dollars (£60) with which were bought 60 milligrams of radium at cost price from Giesel, who scorned to make a profit from a colleague.

In the Department of Chemistry at McGill University, there was a young Oxford physical chemist who joined Rutherford in the investigation of the relation between thorium and thorium X, obtaining results somewhat similar to those of Sir William Crookes with uranium and uranium X. They, Rutherford and Soddy, were able to put forth a most bold and startling theory, which was received at first with scepticism and opposition. Indeed, Lord Kelvin died in unbelief of this great principle, which has now stood the test of time and multitudinous experiments. Atoms were no longer to be regarded as permanent, everlasting and indivisible. Radioactive elements disintegrated spontaneously; they broke up by 'chance', independently of their age or their physical surroundings, or their chemical combinations. The mortality rate was constant for one species, but varied from one type of atom to another. In each case the disintegration took place by internal energy with the projection of an alpha particle (He^{++}) or of an electron (beta ray) and the residual atom was of a new type different from its parent atom. This theory was rapidly developed and applied skilfully to radium, its emanation (radon) and three successive products with the prosaic but useful terminology—radium A, B and C. Rutherford was asked to give the Bakerian Lecture to the Royal Society (1904) and was awarded in consequence the Rumford Medal, and he soon published his first book (1906), entitled "Radioactivity", written with a breathless enthusiasm.

Rutherford's direct advance along the royal road of physics—for he seldom wandered into byways and blind alleys—deterred him from adventures

in mathematical physics. Yet he never seemed to lack the necessary mathematical equipment essential for the interpretation and calculations of his work. Witness the masterly use of exponentials in his Bakerian Lecture, where nothing to-day need be altered or removed. The whole scheme of such calculations, transformations and graphs is familiar enough now to physicists, but it was all new near the beginning of the century.

In 1903, Rutherford had worked out the short-period group of the radium family, but he was faced with really puzzling properties of the long-period group, which necessarily involved observations extending over months. He had, however, 'grown' from radon, and he had detected and isolated, by most ingenious methods, both radio-tellurium (now radium E) and the first radioactive substance found by Mme. Curie—polonium (radium F). These atoms were in the direct line of descent of the radium family, but there was a gap! Radium C did not turn directly into radium E; there was some intermediate body the radiations from which Rutherford was at that time unable to detect. He therefore postulated a 'rayless' change of long period, ten or twenty years, and called the substance radium D, sometimes now called radio-lead, which really ejects beta rays, thoroughly investigated by many workers. But, at the time, this bold prediction of the existence of a material substance, of which no single physical property was known, beyond the fact that there should be an inevitable successor to C, and a forerunner to E, struck me as most remarkable, and on recalling, thirty years later, these circumstances to Rutherford, he was himself impressed. Men may well believe in an undetectable aether, because of its known physical properties, but here was belief in a substance without any properties except that of a go-between!

A great part of the scientific life of Rutherford was spent in his investigation of the properties of alpha particles, and the wisdom of this choice has been abundantly justified by a series of successes. He deflected alpha particles with a magnetic field, and proved that they carried a positive electric charge. He then deflected them to a measured extent both in magnetic and electrostatic fields and thus found both the velocities and the ratio of mass to charge of alpha particles. The inference was that an alpha particle had a mass four times that of a hydrogen atom, and a double positive, electronic charge. This result suggested helium, and the presence of that gas in pitchblende and thorianite was evidence in the same direction. In 1904 Ramsay and Soddy definitely obtained the helium spectrum from aged radon, and five years later Rutherford and Royds

collected the alpha particles, ejected from radon, after their passage through the exceedingly thin walls of a glass container, and again verified the nature of their catch with the spectrum obtained. To forestall a little, it may be pointed out here that Rutherford also used alpha particles in the scattering experiments which proved the existence in the atom of the minute massive nucleus with its positive electrical charge; and yet again in his most remarkable experiments on the artificial disintegration of nitrogen, etc., and on the transmutation of matter, it was alpha particles which he employed as his directed agents.

In the meantime, Rutherford was building up a school of research physicists in his laboratory at McGill. For example, he suggested to H. L. Cooke that because there was radium in the ground, there must be some penetrating radiation (gamma rays) coming upwards from the earth. At first Cooke was not successful in finding what was wanted, but Rutherford persisted: "Try more lead!" There followed a toilsome experiment with very much lead, and finally Cooke not only proved the existence of a penetrating radiation, but also he was astute enough to show that the radiation came from all directions, even from above. This was attributed at the time as coming from the bricks of the wall, etc., but he may have been unconsciously screening his electroscope from cosmic rays!

The arrival of Otto Hahn at McGill was a noteworthy event. He had been working with Ramsay, who had given him some thorianite with the object of extracting some *radium* from that ore, using Mme. Curie's method of fractional crystallization. To the surprise of both Ramsay and Hahn, the residue became more and more powerfully radioactive, while the production of radium was small. The concentration of the residues led to the discovery of a material many thousands of times more radioactive, weight for weight, than the parent thorium. This was an experience similar to that of Mme. Curie when she extracted radium from uraninite. The question was: What was the nature and position of this new substance which Hahn had discovered? He came to Rutherford at McGill to find out. Now on arrival Hahn was naturally excited and enthusiastic, and his English at that time was not altogether adequate, so that at first Rutherford seemed somewhat puzzled and sceptical, but when Hahn showed him the presence of the emanation of thorium (thoron), with a period of 53 seconds, Rutherford was enthusiastic over this discovery of *radiothorium*, an important and powerful member of the thorium family, which decays to half-value in 1.9 years. Hahn continued to work with Rutherford at McGill for a year or so, discovering radioactinium,

and carrying out further investigations of the thorium family, which he has continued with brilliancy in Berlin, and which have justly brought him fame.

Godlewski—a clever and charming Pole—came from Lemberg to work with Rutherford at McGill. We were trying, without much hope, to deflect the gamma rays of radium in a very powerful magnetic field. As expected, it was a null experiment, but Godlewski thought that there might be a better chance with the softer rays of actinium. One morning he showed me his photographic plate with two distinct lines half an inch long, branching like the two horns of an antelope. He had used a magnetic field and reversed it. Again he was dancing with joy and greeted Rutherford: "I have completely deflected the gamma rays of actinium." Rutherford glanced at the plate. "Do it again," he said with a smile. "Certainly, I will do it at once," replied Godlewski; but he tried week after week without a shadow of success, and it may well be wondered what malignant sprite had placed that flaw in just the very place to delude the enthusiastic Godlewski. Alas! he, a physical chemist, died in Lemberg the victim of a slow and undetected escape of gas containing carbon monoxide.

Rutherford and Barnes measured with fair accuracy the heating effect of radium and its products, assigning the proportions between the three types of radiation. Such measurements, in combination with Lord Rayleigh's determinations of the amount of radium in various primary and sedimentary rocks, have settled the long drawn-out controversy between Kelvin and Huxley as to the age of the earth. Indeed there is now an embarrassment of riches, for there is more than sufficient radium in the earth to prevent its cooling, so that, as Rutherford said, the geologist can fill up a blank cheque as he will, and can postulate successive heatings and coolings such as the series of ice ages, and mountain building, and volcanic activity seem to require. Moreover, the amount of lead (radium G), or of helium, accumulated in radioactive ore bodies of various ages affords a useful measure of geological time. Thus it is possible to point to a piece of pitchblende (it may be), and to state with some precision that the specimen has existed in its present compacted form for a period of 700 million years, and it is further possible to give a higher limit (2×10^9 years?) to the 'age' of the earth.

When Dewar discovered the selective absorption of various gases by coco-nut charcoal, he laid the foundation of the modern gas mask. (To Dewar, too, we owe the boon of the thermos flask.) Rutherford checked the selective absorption of radon and thoron and actinon by charcoal,

and told me to measure the amount of radium emanation in the atmosphere, which was in due course completed. Note Rutherford's love of measurement, as a chief essential in physics. He took a lively interest, too, in the scattered or secondary radiations in matter, due to the beta and gamma rays of radium, but after a few months' work by me, suggested that there was not much more to be made of it! Yet this subject has been pursued ever since, culminating in the discovery of the Compton effect, which indicates that a photon ($h\nu$) can collide with an electron, an idea which would have been considered improbable or impossible in earlier times.

Rutherford later showed much interest and gave his powerful assistance in the development of the treatment of cancer by the gamma rays from five grams of radium in the Radium Beam Therapy Research, and he was a strong advocate of a National Radiological Institute, where the great advances in physics could be furthered and made available to physicians and surgeons for the alleviation of the sufferings of mankind. Such a step would be a fitting memorial to him.

It will be noted that Rutherford gave away freely quite important researches—indeed, he gave far more than he retained for himself. Whether at Montreal, Manchester or Cambridge, he not only made discoveries himself, but also at each place he was the centre of a galaxy of workers who became remarkably prolific both in the quantity and quality of their discoveries. In common with many others, I am deeply grateful for staunch help and unruffled kindness extending over more than a third of a century.

Here was a man of the greatest intellectual power, who has altered the whole viewpoint of science, who accomplished an amazing amount of work of the first order, a physicist who obtained the highest prizes in life, who ranks among the greatest scientific men of all ages; well, it is pleasing to remember that he enjoyed life to the full. True, the sudden death in 1930 of his only child Eileen, wife of Prof. R. H. Fowler, was indeed a staggering blow, only in part relieved by his great affection for his four grandchildren.

Much as we deplore the death of Rutherford while still at the peak of his powers, much as we anticipated a rich harvest from the recent improved facilities at the Cavendish, much as we miss and shall continue to miss his crystal-clear expositions and yet more his friendly and delightful personality, yet who would wish to have seen that bright intelligence wane or gradually fade? He was always a charming blend of boy, man and genius, and it may still be true that those whom the gods love die young.

A. S. EVE.

It was in 1909 that I first came into contact with Rutherford, in my second year in the honours school in Manchester. Owing to some changes in the staff, Rutherford took over a course of lectures on electromagnetism. This was a stimulating experience, for Rutherford was interested in the subject and his account of his own early work remains with me a vivid memory. In our third year some of us were drafted into research work—into the firing line as he would put it—to our great joy and, on occasions, alarm and terror. At that time his main line of work was the study of the properties of the α -particle, already begun in Montreal and continued with increased vigour in Manchester. The counting of the α -particles and the measurement of their charge (both with Geiger) gave a value for the unit of charge which was accepted for some years and showed that the α -particle should be a helium atom. The direct proof followed in the beautiful experiment with Roysds. At the same time, the phenomena accompanying the passage of the particles through matter were investigated—the ionization, the ranges of the particles from the different radioactive bodies, the change of velocity and the scattering of the particles.

These latter experiments, carried out by Geiger and Marsden, proved to be of special importance, for they led Rutherford to his conception of the atom as a heavy, positively charged nucleus surrounded by a cloud of electrons in appropriate number. I remember well the occasion on which this idea was first put forward. It was at a meeting of the Manchester Literary and Philosophical Society, to which all workers in the laboratory were invited. Rutherford's account of his theory, backed by Geiger with a description of some new experimental evidence, created a profound impression.

The nuclear theory was the culmination of Rutherford's work on the α -rays, and the finest of all his great contributions to physics. It is scarcely necessary to say that it is the foundation on which all the subsequent developments of atomic physics have been built. The history of this discovery shows very clearly one of the most typical aspects of Rutherford's genius—his extraordinary gift for seizing on the vital point. The discrepancy between Geiger's measurements of the scattering of α -particles through small angles and the apparently trivial observation that a small fraction of the particles which fell on a thin foil were scattered backwards led him straight to the goal. These simple experiments were sufficient to give him the general picture of atomic structure, though further work was necessary to fill in the details. A complete proof of the theory was given some time later by Geiger and Marsden in a series

of magnificent experiments, which also showed that the atomic nucleus was of very small dimensions, and gave (roughly) the size of its charge.

The full implications of the nuclear theory were only gradually appreciated. There followed van den Brock's suggestion that the charge on the atomic nucleus was determined by the atomic number, established in Rutherford's laboratory by the famous experiments of Moseley on the X-ray spectra of the elements. The story of Bohr's visit and his development of the nuclear atom to explain spectroscopic series and atomic phenomena is so well known that it needs no repetition here, although this development now covers the whole field of atomic physics. There was further the application by Russell in Manchester, and elsewhere at the same time by Soddy and by Fajans, to explain the chemical properties of the radio-elements.

Meanwhile, Rutherford, continuing work on the α -rays, also began to turn his attention to the β - and γ -rays. With Andrade, he obtained for the first time a spectrum of the γ -rays by diffraction from a crystal; while, with Robinson, he investigated in great detail the line spectrum of β -rays and also showed the connexion between the γ -rays and the β -ray lines, a connexion which in later years has been used with great effect in the study of both β - and γ -ray spectra.

These years, 1907–14, were perhaps Rutherford's greatest period. A stream of papers on all aspects of radioactivity poured from his laboratory, nearly all of outstanding importance. There would be generally about twenty or so workers, including the staff of the laboratory, who in spite of heavy teaching duties yet found time for research. A large proportion of the workers were visitors, for he attracted men from many countries. It seems invidious to mention any names when it is impossible to give all, but as I have already transgressed perhaps I may be forgiven for adding those of Boltwood (a great friend of Rutherford's), von Hevesy, Fajans, Gray, Boyle, Kovarik, Darwin, Russ, Makower, Evans and Florance. And I am sure Rutherford himself would have wished me to add again the name of Geiger, who collaborated in so much of his work and who helped him in many different ways.

The period of the Great War was, of course, relatively unproductive; but in the intervals snatched from other activities, Rutherford pursued his course. He was now speculating about the structure of the nucleus, and when I returned to the laboratory at the beginning of 1919, he had just succeeded in showing that the nucleus of nitrogen could be disintegrated by bombardment with an α -particle. This was a discovery second only to his nuclear theory and the transformation

theory, but its great importance was not fully recognized at the time, probably because it remained an isolated fact for some years. With this experiment, however, he opened up a new field of inquiry, nuclear physics, in which there is now such great activity.

In 1919, Rutherford succeeded J. J. Thomson as Cavendish professor of experimental physics in Cambridge. He left Manchester with many regrets, for he had been very happy there and he had made many friends both in the laboratory and outside it. He began in Cambridge to pursue with characteristic energy the paths marked out by his work in Manchester. It was at this time that I came to know him well, for he invited me to join him in continuing the experiments on the artificial disintegration of elements by α -particles. He had long had a special love for the α -particle, but now the nucleus also was admitted to the same intimacy, and the experiments bearing on nuclear structure were his main interest. After the first rapid advances, progress became rather slow, owing to difficulties inherent in the method of experiment. But Rutherford never lost his faith in the ultimate success of this work. The development of electrical methods of counting particles enabled many striking advances to be made, elsewhere as well as in the Cavendish, and the subject of nuclear physics began to open up rapidly.

The real reward for his efforts to develop this field of work came in the spring of 1932, first with the discovery of the neutron, a particle the properties of which he had anticipated several years before and for which he, and I, and others in the laboratory, had previously searched in vain, and shortly afterwards with Cockcroft and Walton's disintegration of elements by protons—disintegration for the first time by means under human control. I mention these two discoveries particularly, not only because of their special significance but also because they are the fruit of his policy and direction. If they do not bear his name, these discoveries bear the stamp of his laboratory, and his delight in them was as great as if he had made them himself.

Many advances of almost equal importance were made during this period 1919-37, so many that it is impossible to mention them one by one. The number of men who took part in these advances is so large that a list of only the most notable names would be inordinately long. The reputation of the Cavendish Laboratory won under Maxwell, Rayleigh and J. J. Thomson was maintained and even increased. The laboratory itself spread in size and received, as an independent satellite, the Royal Society Mond Laboratory under Kapitza.

I have said that the Manchester days were Rutherford's greatest period. This is true so far

as his own direct contributions to physics are concerned, but it is not true in other ways. In Manchester his research students were mostly senior men who had already won a reputation. In Cambridge conditions were different. There were, of course, a number of senior workers, but the young men with little or no previous training far outnumbered them. Rutherford recognized very clearly that the training of such large numbers of students would hamper the progress of his own work, but he accepted it as his duty. He gave the most careful thought to the problems on which he put his students, so that these should begin within their powers and lead to a well-marked and profitable line of research. He kept his eye on every man, expecting and at times demanding the best the man could do, and inspiring him with his own enthusiasm. When the time for publication came he read the paper with the greatest care, often making what changes in presentation he thought desirable, even to the extent of re-writing whole sections. No paper left the laboratory until he was satisfied. It would be difficult to over-estimate his services and his influence in these directions, for there can be few if any universities in the British Empire which do not contain at least one of Rutherford's students. He came to regard the training of students in methods of research as of almost equal importance to the advancement of knowledge.

Even the casual reader of Rutherford's papers must be deeply impressed by his power in experiment. One experiment after the other is so directly conceived, so clean and so convincing as to produce a feeling almost of awe, and they come in such profusion that one marvels that one man could do so much. He had, of course, a volcanic energy and an intense enthusiasm—his most obvious characteristic—and an immense capacity for work. A 'clever' man with these advantages can produce notable work, but he would not be a Rutherford. Rutherford had no cleverness—just greatness. He had the most astonishing insight into physical processes, and in a few remarks he would illuminate a whole subject. There is a stock phrase—"to throw light on a subject". This is exactly what Rutherford did. To work with him was a continual joy and wonder. He seemed to know the answer before the experiment was made, and was ready to push on with irresistible urge to the next. He was indeed a pioneer—a word he often used—at his best in exploring an unknown country, pointing out the really important features and leaving the rest for others to survey at leisure. He was, in my opinion, the greatest experimental physicist since Faraday.

I cannot end this tribute to Rutherford without some words about his personal qualities. He knew

his worth but he was and remained, amidst his many honours, innately modest. Pomposity and humbug he disliked, and he himself never presumed on his reputation or position. He treated his students, even the most junior, as brother workers in the same field—and when necessary spoke to them 'like a father'. These virtues, with his large, generous nature and his robust common sense, endeared him to all his students. All over the world workers in radioactivity, nuclear physics and allied subjects regarded Rutherford as the great authority and paid him tribute of high admiration; but we, his students, bore him also a very deep affection. The world mourns the death of a great scientist, but we have lost our friend, our counsellor, our staff and our leader.

J. CHADWICK.

I HAVE been asked by the Editor to give a brief account of my personal recollections of the late Lord Rutherford. I met him first in October 1895, when a regulation had just come into force by which graduates of other universities were admitted to Cambridge as 'research students', and after two years residence were eligible for the B.A. degree. Rutherford was the first student to apply; he was succeeded in an hour or so by J. S. Townsend, who has since become Wykeham professor of physics at Oxford, so that the first two research students became professor of physics at Cambridge and Oxford respectively. Rutherford when in New Zealand had invented a magnetic detector of wireless waves and his first work in the Cavendish Laboratory was to try to improve its sensitiveness. He showed even at this early stage that he possessed exceptional 'driving' power and ability as an organizer. To test his detector, it was necessary to take observations simultaneously at two places, and the transport of the instrument required organization. He surmounted these difficulties by getting assistance from his friends, and at one time held the record for long-distance wireless in England, having observed at the Laboratory signals which came from the Observatory about two miles away. He had not worked for more than a very few weeks before I became convinced that he was a student of quite exceptional ability.

Whilst Rutherford was engaged with this research, Röntgen rays were discovered and we had found at the Laboratory that when these passed through a gas they made it conduct electricity even with the smallest electric forces. For ten years experiments on the passage of electricity through gases had been going on in the Laboratory; these were excessively difficult as the only ways

of getting the electricity to pass through the gas were to use large electric forces and so get sparks, or make the gas so hot that you got flames. Both these were exceedingly capricious in their behaviour. The Röntgen rays gave a very simple and reliable means of making the gas conduct electricity even under the smallest forces, put researches on gases on quite a different footing and promised to add greatly to our knowledge of the subject. Rutherford devised very ingenious methods for measuring various fundamental quantities connected with this subject, and obtained very valuable results which helped to make the subject metrical, whereas before it had been only descriptive.

Yet another fundamental discovery was made while Rutherford was working in the Laboratory, that of radioactivity, which in one form or another occupied his attention for more than twenty years. Henri Becquerel found in 1896 that salts of uranium gave out radiation which, like Röntgen rays, could penetrate opaque bodies and affect a photographic plate. The radiation was not all of one type: one part of it was very easily absorbed; another part could penetrate much greater distances and was deflected by magnetic force in the same direction as a negatively electrified body, and a third, present only in small quantities, seemed even more penetrating than the second. In 1918 Rutherford made a careful study of these types of radiation, which he called α , β , γ , a notation which is now universally used; he did not find any irregularities, and commenced a study of the radiation from thorium. He had not completed this when he was elected to the professorship of physics in Montreal in succession to H. L. Callendar, who was also a Trinity man and who had worked in the Cavendish Laboratory with remarkable success.

Rutherford had not been long enough in Cambridge to entitle him to be able to sit for a fellowship when he was elected to the professorship and left Cambridge for Montreal. When he got there, he resumed the experiments on the thorium radiation. These, until the clue was found, were terribly perplexing; what seemed a trivial thing such as a puff of air would produce a great difference in the radiation, while large changes in temperature produced no effect. The thorium seemed to infect bodies placed near it and make them radioactive; they recover after a time if the thorium is taken away. These anomalies, though troublesome, were really a blessing in disguise, for in his attempt to account for them, Rutherford arrived at the view about the processes going on in radioactive substances which is now universally accepted. His view was that the thorium, besides giving out radiations, gives out a radioactive gas which he

called an emanation. This may be wafted about, or settle on solids and make them appear to be radioactive. The emanation is not permanent, but after a few hours changes into non-radioactive substance.

Rutherford's scientific activity was never greater than when he was at Montreal. In the years between coming to Cambridge and leaving Montreal to be professor of physics at the University of Manchester, he had published between forty and fifty papers; a few of these were joint papers, but the great majority were about researches of his own which had led to results of first-rate importance and which could not have been obtained by anyone who was not an experimentalist of the very first order. In those days, laboratories had no funds to buy instruments as sensitive as those which are now available, and to detect small effects required exceptional skill, patience and self-criticism.

After Rutherford went to Manchester, I did not see much of him until 1915, when Mr. Arthur Balfour, as he was then, created the Board of Invention and Research for the co-ordination and encouragement of scientific effort in connexion with the Great War. Lord Fisher was the president of the Board, and I was a member of the Central Committee. The most pressing need at the moment was some means of detecting submarines. We got Rutherford to draw up a report on the methods which had been used or suggested for this purpose. He reported strongly in favour of a particular method, and we were fortunate enough to secure the services of Prof. W. H. (now Sir William) Bragg as director of a research for this purpose, and provided him with a laboratory and staff. Rutherford also visited the United States to find out what they were doing in this matter and to tell them what we were doing. His help was continually being asked on a great variety of questions and there was no one whose opinion carried greater weight.

The Cavendish Laboratory has made great progress under his direction; the Mond Laboratory for magnetic research and the High-Tension Laboratory have been created. When he came, the supply of instruments for research was too scanty; it is now in this respect one of the best equipped physical laboratories in existence. Lord Rutherford's activities were very wide-spread; he was professor of natural philosophy at the Royal Institution, and also held with conspicuous success the very responsible post of chairman of the Advisory Council of the Department of Scientific and Industrial Research. That he could discharge so many duties was due to his powers of organization and that his claim to know a good man when he saw him was amply justified by results. With this faculty he could delegate some of his work to

others without injury to the efficiency of the Laboratory, and get time to spare for his other activities. His death just on the eve of his having in the High-Tension Laboratory means of research far more powerful than those with which he had already obtained results of profound importance is, I think, one of the greatest tragedies in the history of science.

J. J. THOMSON.

THE splendour of Rutherford's contributions to science excites a wonder as to the means by which he could achieve so much. He made no claim to great mathematical ability, and many an experimenter has had fingers more clever than his. Yet he conceived and carried out a series of researches which have played a leading part in the marvellous advances of modern physics. To begin with, he brought to his work an intense interest, a tireless vitality, a singleness of purpose, a simplicity of conception and a bravery of attempt which carried him straight to the point.

Rutherford had to a remarkable degree the power of seizing on the essentials; and he not only saw what was unimportant but also rode over it and through it remorselessly. This was true indeed of all his dealings: he had a well-earned reputation for speaking plainly. But he was very kind and generous, and a loyal friend. He was tactful, and full of consideration for all who were trying to do the right thing. One of his lovable characteristics was his constant care that all who worked for him, and indeed all workers, should have full credit for what they did. In any company of men he was extraordinarily quick to appraise the value of what each man said, and indeed the worth of the speaker himself, so that his own clearness and honesty of purpose, his force of statement and his shrewd judgment would carry the company with him. Thus he was a great administrator and guide.

In the laboratory his helpers went forward strongly and confidently towards the conclusions which he himself anticipated so clearly. So perhaps we may understand why such fine work came from the laboratories which he successively controlled, and why in these days physical science has been so greatly enriched.

W. H. BRAGG.

WITH the passing away of Lord Rutherford*, the life of one of the greatest men who ever worked in science has come to an end. For us to make comparisons would be far from Rutherford's spirit, but we may say of him, as has been said of Galileo,

*A short tribute given at the Galvani celebrations in Bologna on October 20.

that he left science in quite a different state from that in which he found it. His achievements are indeed so great that, at a gathering of physicists like the one here assembled in honour of Galvani, where recent progress in our science is discussed, they provide the background of almost every word that is spoken. His untiring enthusiasm and unerring zeal led him on from discovery to discovery, and among these the great landmarks of his work, which will for ever bear his name, appear as naturally connected as the links in a chain.

Those of us who had the good fortune to come into contact with Rutherford will always treasure the memory of his noble and generous character. In his life all honours imaginable for a man of science came to him, but yet he remained quite simple in all his ways. When I first had the privilege of working under his personal inspiration, he was already a physicist of the greatest renown, but nevertheless he was then, and always remained, open to listen to what a young man might have on his mind. This, together with the kind interest he took in the welfare of his pupils, was indeed the reason for the spirit of affection he created around him wherever he worked.

Rutherford passed away at the height of his activity, which is the fate his best friends would have wished for him, but just on account of this he will be missed more, perhaps, than any scientific worker has ever been missed before. Still, together with the feeling of irreparable loss, the thought of him will always be to us an invaluable source of encouragement and fortitude. NIELS BOHR.

RUTHERFORD'S death removes from science the most outstanding personality of the age. My most vivid memories naturally date from the autumn of 1900 and the two subsequent years when I worked with him at McGill. A born experimenter, entirely devoted to his work and with few, if any, outside interests, I can see now more clearly than I did then how he neglected no opportunity or preparation the better to advance it. Though the qualities for which in later life he was so publicly beloved were then still undeveloped, yet undoubtedly they existed and they helped to leaven the McGill of those days and to make it the enchanted place it was. The personal familiarity with the man, and his methods of work in the laboratory, that I gained in those years remained, of course, an abiding possession. Yet I do not think it was entirely, if at all, this that later was to make all his scientific communications a unique pleasure to read. True, admiration for some new and striking advances was pretty sure to be evoked, but over and above

this they seemed to radiate an entirely undefinable charm.

In the last phase, since the Great War, this extended from his writings to his public lectures and appearances. The intense absorption in abstruse scientific problems, which in others is a hindrance to wide social intercourse, was in him combined with such vitality and magnetism that others were attracted rather than repelled. As has been well said, he was able to vitalize any public gathering and make it the happier merely for his coming.

In the last letter I had from him, asking me why I had resigned, he told me he did not expect to do so for some years, as he was feeling very fit and well, and able to hold his job down. The Fates have otherwise decreed. He reached, perhaps even did not quite reach, the summit of his powers, but for him there was to be no slow and inevitable decline. F. SODDY.

It is hard to think of Rutherford as a man whose life is finished, that we shall no more see his steady eyes and hear the familiar voice, now asking placidly about some domestic trifle as any friend might, now growing hurried and excited when ideas about some physical problem were coming almost too fast for his tongue. There can seldom have been a man in whom burning genius was so closely associated with the kindly commonplace, who at any moment might suddenly become inspired, and a little later might be showing a boyish naivety about some question of another kind. His ability to excite affection was as marked as his power of commanding admiration: his foibles were essentially those of a frank and simple nature, the charm of which remained unspoiled, and was even enhanced, by successes that might well have turned the head of a lesser man.

I like to think of him as he was at Manchester, where I first came to know him. Of this time he might have said, in Newton's words, "for in those days I was in the prime of my age for invention, and minded philosophy more than at any time since." He was free from any grave cares of administration, his duties outside the laboratory were light, and he had leisure himself to experiment with his own hands and eyes, as he loved to do. He organized his students as a team for radioactive research, allotting to each a task within his capacity, and urging him on in energetic fashion if urging was needed. Our belief in him was implicit: if Rutherford said that an experiment could be done, then it could be done, and the sooner it was done the better.

Rutherford was a young man with the rest of us, sharing our jokes and showing us how to overcome our difficulties. His nickname in those days

was "Papa", perhaps arising from the paternal way in which he put us right about anything that had to do with radioactivity. But he was a very young father of a family and extremely unconventional. When things were going well, and new discoveries were coming out at the rate of about one a week, a tune recognizable by the elect as "Onward, Christian Soldiers" could be heard accompanying the Professor's steps along the corridors: when things were going less well another tune, no less holy, held sway.

It must not be thought that his interests were limited to radioactivity, or to any other particular branch of physics. I well remember him cross-examining A. D. Fokker about relativity, and any other visitor had to tell him all about the work in which he, the visitor, was expert. The theme of the laboratory in the few years before the Great War was, however, the structure of the nuclear atom, which he had put forward in 1911. In the laboratory during this period were Niels Bohr, H. G. J. Moseley, C. G. Darwin, J. Chadwick, H. Geiger, H. R. Robinson, J. M. Nuttall, E. Marsden, D. C. H. Florance, J. A. Gray, R. W. Boyle, H. B. Boltwood and A. Kovarik, to quote a few remembered names. Those were good days. Other great men will, no doubt, arise, but it is unlikely that any of us who worked with him in

those days will live to see another such genius at the height of his powers, the leader and friend of such a school.
E. N. DA C. ANDRADE.

LORD RUTHERFORD's death is a calamity for the Department of Scientific and Industrial Research. In the seven years during which he has been chairman of the Advisory Council, his influence has made itself felt throughout the Department. His broad sympathies, lively imagination, and deep insight equipped him in a wholly exceptional way to direct and strengthen the links between the Department and industry. It was an article of faith with him that the future of Great Britain depends upon the effective use of science by industry. It was this faith which induced him, a man of the highest attainment in the field of pure scientific research, to devote himself, as he did unreservedly, to our work. The development of the research association movement, now taking place, owes much to his foresight, sympathy and advocacy. Equally stimulating was his influence on the scientific work of the Department. In our counsels he leaves a blank which cannot be filled; and the loss of his unsparing service, his genial personality, and his warm-hearted encouragement, may well fill the stoutest heart with dismay.
F. E. SMITH.

The Funeral of Lord Rutherford

WITHIN the ancient walls of Westminster Abbey and in the presence of a large gathering of men eminent in many walks of life, at noon on Monday, October 25, a typical English autumn day, the last remains of Lord Rutherford were laid to rest in the Nave near the graves of Newton, Kelvin, Darwin and Sir John Herschel. Thus another link was forged binding the Empire together, for Rutherford was the first man of science born in the overseas dominions to be buried in the Abbey. The honour thus accorded him is fitting recognition of the place he held among his fellows, and the memorable service at his burial, in its simplicity, beauty and dignity, was in keeping with the passing of a man of singleness of purpose whose whole life had been devoted to unravelling the secrets of Nature. There was no pomp or pageantry such as is seen at the burial of our great naval and military leaders, no word was said of his life or achievements, but a quiet air of sincerity pervaded the whole scene and left an indelible impression that it was all as he would have wished.

Among the large congregation, H.M. the King

was represented by Lord Fortescue (Lord in Waiting). The Prime Minister was represented by Mr. G. P. Humphreys-Davies, the Lord Chancellor by Mr. Vernon Harington. Lord Halifax (Lord President of the Council), Lord Swinton (Secretary of State for Air), Sir Samuel Hoare (Secretary of State for Home Affairs), Sir Thomas Inskip (Minister for Co-ordination of Defence), Earl Baldwin and Mr. Ramsay MacDonald were present. Rear-Admiral A. Bromley represented the Secretary of State for Dominion Affairs and Admiral of the Fleet Lord Chatfield represented the Admiralty.

The ten pall-bearers were the High Commissioner for New Zealand, Prof. H. R. Dean (Vice-Chancellor of the University of Cambridge), Lord Dawson of Penn (president of the Royal College of Physicians), Sir William Bragg (president of the Royal Society), Sir Edward Poulton (president of the British Association), Prof. A. S. Eve, of McGill University, Prof. E. D. Adrian, of Trinity College, Cambridge, Sir Frank Smith, of the Department of Scientific and Industrial Research, Prof. W. L. Bragg, of the University of Manchester, and Sir George Lee, president of the Institution of Electrical Engineers.

The service began with the singing of the sentences "I am the resurrection and the life . . ." while the coffin containing the urn with the ashes was borne slowly through the Nave and Choir to the bier placed in front of the Sanctuary and beneath the Lantern. Then followed the singing of the 23rd Psalm, the reading of Ecclesiasticus, xlv, 1-14, prayers and the hymns "The King of Love my Shepherd is" and "Praise, my soul, the King of Heaven". With the congregation standing, the coffin was then carried back to the Nave, followed by the mourners and chief representatives, and the committal took place. Owing to the recent death of the Dean, the Right Rev. W. Foxley Norris, the service was conducted by the Sub-Dean, Canon V. F. Storr, and it was his voice the congregation last heard as he pronounced the Blessing. The service was brought to an end with the organist playing Harwood's *Requiem Aeternam*. After the departure of the chief mourners, those present were permitted to file past the flower-strewn spot where the urn rested, and above which will be placed the slab bearing the name of Rutherford.

On this occasion it is of interest to recall something of the other eminent men of science buried or commemorated in the Abbey; for as Dean Stanley wrote, the characteristic of Westminster Abbey which most endears it to the nation is the fact that it is the resting place of famous Britons, from every rank and creed, and every form of mind and genius. The earliest connexion of the Abbey with modern science and with the Royal Society goes back to the seventeenth century, when Sir Robert Moray, the first president of the Royal Society, was buried in the centre of the South Transept at the expense of Charles II. He died in 1673. Two years later, Dr. Thomas Willis, one of the earliest professors of natural philosophy at Oxford, was buried in the Abbey, and his interment was followed in 1677 by that of Isaac Barrow, the first Lucasian professor at Cambridge and the Master of Trinity. Both his grave and monument are in Poets' Corner. Just half a century separate the burials of Barrow and of Newton; but in the interval Dean Sprat, the first historian of the Royal Society, was buried in St. Nicholas's Chapel, and Thomas Tompion, 'father' of English clockmakers, was buried in the centre of the Nave.

Newton died on March 20, 1726 (O.S.) or March 31, 1727 (N.S.). For several days his body lay in state in the Jerusalem Chamber and then was buried on the south side of the Nave near the Choir. "His countrymen honoured him in his lifetime," wrote Voltaire, who was in London, "and interred him as though he had been a king who had made his people happy." Though there are

memorials to men of science in many parts of the Abbey, it is around the grave and monument of Newton that the greatest number are to be found. Just in front of the monument are the tablets to Kelvin, Maxwell and Faraday, a little farther off are the gravestones of Telford and Robert Stephenson, while in the grave of Tompion lies also the body of his pupil and successor "Honest" George Graham, who on November 24, 1751, at night, was brought from his house in Fleet Street and laid with his master. To the north of Newton's grave, in the Aisle, are the graves of Darwin and Herschel, and a little farther to the west those of Lyell and John Hunter. Like Boyle, Hunter was first buried in St. Martin-in-the-Fields. Boyle's grave was lost sight of through the rebuilding of the church, but Hunter's coffin in the vaults of the new church was discovered by Frank Buckland, and through the action of the Royal College of Surgeons in 1859, was removed to the Abbey.

Also in the north aisle, but to the east of the grave of Darwin, are the eight memorials clustered around the tomb of Sir John Thynne, a zealous Sub-Dean of the Abbey. Here in 1888 was placed the medallion of Darwin, and beside that are now memorials to Joule, John Couch Adams, Sir Joseph Hooker, Alfred Russel Wallace, Sir George Gabriel Stokes, Lord Lister and Sir William Ramsay. The ten windows lighting the aisle are also memorials, and on some of them are to be found the names of Richard Trevithick, Isambard Kingdom Brunel, Robert Stephenson, Lord Kelvin, Sir Benjamin Baker and Sir John Wolfe-Barry. There were once windows to the memory of Joseph Locke and Sir William Siemens, but these have been removed.

Of the other memorials in various parts of the Abbey, the group in St. Andrew's Chapel is the most interesting, for here, beside the statue of Telford, are the tablets to Sir Humphry Davy, Thomas Young, Dr. Matthew Baillie the anatomist, Sir James Simpson and Lord Rayleigh, and also the monument to Sir John Franklin. Not far away, in St. Paul's Chapel, is to be found Chantrey's great statue of Watt, whilst elsewhere are to be found the graves or monuments of Sir William Spottiswoode, Sir John Pringle and Martin Folkes, three presidents of the Royal Society, John Woodward and Dean Buckland, Major James Rennell, Sir Stamford Raffles and the young Lancashire clergyman and astronomer Jeremiah Horrocks, who on November 24, 1639, was the first to observe a transit of Venus. Horrocks died in 1641, but at the time of the transit of 1874 a memorial, placed within that of Newton's nephew, John Conduitt, at the west end of the Nave, was erected with an inscription upon it by Dean Stanley.

Science and the Community*

By the Right Hon. J. Ramsay MacDonald, P.C., M.P., F.R.S.

I MUST begin by expressing two things that are upmost in my mind at this moment: the thanks we all owe to Mr. Radford Mather, the generous founder of these lectures, and the honour I feel at having been asked by the Council of the British Association to deliver the first of them. Mr. Radford Mather has been impressed by the importance of the work of the scientist in the ordinary everyday life of our people, especially at this moment; and, after a long life enlivened by scientific and social interest, he feels keenly that a recognition of that work is not only owing to the scientific worker himself, but also will be helpful in inducing the public to use the advantages which the scientist has put at its disposal.

The history of scientific discovery and the application of scientific knowledge to human activities in every field reads like a romance, and I can imagine no more interesting career for anyone whose tastes lie in that direction. The interest and importance of the scientific career, however, are not confined to the laboratory or the classroom, but should be regarded as a major, if indeed not the major, creative influence on this generation. In national economic well-being, especially in making high standards of living possible, in the evolution of both the powers and forms of national institutions, in the efforts to create and secure social harmony and co-operation, the scientific method, if followed, would be of great assistance and would save some futile experiments, mistaken agitation and unworkable proposals. Thus, the politician as well as the professor, the housewife as well as the manager of great works, whether they are aware of it or not, depend in the performance of their work upon whether the public mind not only responds emotionally but also sets about making that response with the same care as to facts and the same anxiety as to methods as the man of science shows in his special field. What are called 'moving' descriptions of human ills, quite accurate as to facts but left without carefully studied conclusions as to treatment, often become serious obstacles in the way of satisfactory remedies.

In all public affairs I myself am an unrepentant evolutionist. There must be changes, not for the sake of change, but because social harmony and progress require it. Were it not so, civilization itself would soon become a relic, and we should have to deal with a society which has breathed its last progressive breath and has reached the stage

of disruption through evolution, because it is not adapting itself to the new conditions which are the immediate offspring of its own life. Civilization is not a static state but one of dynamic activity which requires direction. The most lasting and fruitful of changes are those which arise from the failures of existing conditions or their hitherto imperfect successes. Or we may put it this way in full accordance with the truly scientific mind: Creation was left imperfect for man to carry it on towards completion by coming to understand it, both as an accomplishment and a promise. The place where the shoe pinches either body or mind is the spot where disruptive unsettlement shows itself first. The remedy is not to curse the shoe nor to content ourselves by describing the pains. The shoe should be adapted so that it may be useful (as it was intended to be) without doing what it was never meant to do—rack us with pain.

Pain in the individual corresponds with discomfort and unrest in the community. Both are signals of harmful processes and call for study and treatment in the scientific spirit, in order to prevent more serious results—serious illness and death in the individual, revolution and disruption in the community.

By the scientific method it might often be possible to prevent even the pain and unrest. This optimism in progress, however, assumes that an awakened interest in the work of the experimental scientist will incline the public to follow, in its own special concerns, the methods and spirit of the scientist himself. I make no plea for the scientist as statesman. He will not be likely to be any better than Plato's philosopher. The plea I make is for a practical democracy, but if democracy is to triumph in the attack now being made upon it, it must have a method, and I believe that the records of the scientific worker and the way he sets about his work will steady and clarify the popular mind not only to complain eloquently, but also to conclude wisely.

In these days, when science is renewing its claims to be regarded as an essential part of cultural education and to rank in value with the humanities for that purpose, it must be able to show that its pursuit is not only to discover facts, but to influence values of life as well, and that it can not only put power into men's hands, but also quicken the human qualities of mind which take care that that power is used for human well-being

* From the first Radford Mather Lecture of the British Association, delivered at the Royal Institution on October 22.

and progress. The scientist as citizen should take a lively concern in the way his discoveries are used. Prof. Lancelot Hogben contributed a thought-provoking paper to the Blackpool meeting in which he emphasized this dictum: "The cultural claims of science rest on the social fact that the use and misuse of science immediately affects the everyday life of every citizen in a modern community."

If at the end of a generation the great contribution that scientific activity has made to the life of the community is to produce a power of destruction which can be used to appal the most indifferent to human suffering and injustice, the labours of the scientist of our time run the risk of being permanently deplored. This is now being widely recognized by scientists themselves. On the other hand, the part which our present scientific research can play in social well-being and solidarity depends upon an enlightened popular view of the value and significance of those researches and their uses.

Standards of life have undoubtedly been raised and opportunities for improving wages provided, whilst leisure has been extended and the conditions under which people work, even in spite of some serious shortcomings, greatly improved. Human stress and strain have become considerations in work, and the adaptability of the individual to employment has greatly eased the discomforts and disappointments of the worker. These tendencies have by no means exhausted themselves, and an enlightened determination to maintain the conditions of uninterrupted consumption of products by increasing the share of the worker will minimize the hardships of any at-present-uncontrollable slackening in the market demands for production and labour.

The needs dealt with by these scientific investigations cover an extraordinarily wide field indicated with interesting clarity in the annual reports of the Department of Scientific and Industrial Research and its organizations, such as the National Physical Laboratory. From these it is seen that organized research extends apace, and that the co-operation between scientists and industrialists has become a well-marked feature in our industrial life. Industry is no longer satisfied with sporadic consultations with science. This has led, as the last annual report of the Department of Scientific and Industrial Research records, to a steady improvement of the efficiency of our industry and the comforts of the working staffs.

Furthermore, there is a steady growth of the acceptance of scientific effort on the part of industrialists, and a spirit of co-operation between the scientist and industrialist has been developed to an encouraging degree, so much so that we may well say that we have been witnessing the creation

and development of a new industrial organ with a well-marked function.

I must limit my excursion into those fields to which modern scientific discoveries are leading us, which have been so interestingly dealt with in papers read at the Blackpool meeting of the British Association last year, and which find a voice in some most challenging articles in recent issues of the scientific press. Nor will scientists fail to observe the meaning of that most significant resolution passed by the recent Trade Union Congress agreeing to a Committee of Scientists with whom Congress can consult on policy, outlook and methods of handling their special work. Thus a scientific front is being created, with the co-operation of all classes and interests, to encourage scientific inquiry and to use it to promote communal well-being.

The advance in the investigations of the scientist is not, however, universally welcomed. The reason is that science and machinery mean pretty much the same thing in the public mind, and two accusations are made against machinery which are in very many minds as they see what wonderful things science has done in recent years. The first expresses a general doubt whether this machine age has brought us any benefit at all, and is anything more than an unfortunate by-road in world history. It is argued that, in pursuing the machine, man has lost his soul and those qualities which proved that he had a soul. That great question in aesthetics cannot be dealt with in this lecture even as a side issue. I believe that a very large part of the case for it is based upon the misuse of science for which the man of science has nothing to do, and cannot be blamed. But, further than that, I am not at all sure but that science will be found to provide the antidote—conditions of leisure and culture which will enable us to rediscover the qualities of life which modern society is said to have lost.

In many quarters science is regarded as the enemy of human beings who desire to live as self-supporting workers. So has it always been at times of great change in industrial production. A reply which reminds us of the experiences of labour in history, that the displacement of men by machinery has always been but temporary and that with an increase in national wealth we also have an increase in the national demand for labour. There is some evidence that that experience is being repeated to-day. It is, however, rather unconvincing to the man who actually finds himself unemployed because a machine more efficient than himself as a producer has taken his place in mine and factory. Be that as it may, machinery which takes the place of the hard, uninspiring and deadening drudgery of human

beings is all to the good, and that which multiplies the efficiency of human skill is also all to the good. Human safeguards and benefits come from other directions—mainly from an increase in leisure, the enjoyment and use of which are amongst the most pressing of social problems to-day. And there is another pressing problem in front of us. How to reduce cost of production without lowering standards of life? Scientific invention properly used, I believe, will give us a chance to solve both problems.

The other trouble is kept fresh and urgent by what we read every day in our newspapers of the great advance due to science in the destructive forces of the world, as shown in China and Spain, and will be repeated with increased horror wherever war breaks out. If we cannot avoid war, we cannot avoid the very worst that can happen in warfare. But this raises issues which depend upon other considerations than those of the field of science. Science increases power which can be applied both to life and death. The men who have made air forces possible, for example, have also created civil air fleets, and if the communities cannot make and keep peace, or if they are so blind as to follow the aggressive actions of their rulers, democratic or dictatorial, the consequences are theirs. If peace is not secured by, say, diplomacy and the will not of one but of all nations, it is both a false judgment and a cowardly one to blame the scientific engineer and worker. The action of the farmer in growing corn and food for war is exactly of the same kind as the engineer who makes flying engines. Peace or war is not the responsibility of scientists *as scientists*, except in very special cases, so long (and it will always be) as the discoveries which increase our peaceful and beneficial resources can be used for war machinery.

At the same time, there is a feeling amongst many scientists that the ease by which their labours may be misused in this way should make them, as citizens, sharers in creating and upholding the public opinion of the nations to which they belong, interested in protecting their work from being outrageously abused as beneficial poisons can be.

I have presided over various international conferences of chemists, engineers and others interested in this question, and one and all gave a hearty response to every mention of this interest and duty of theirs. Scientists will also remember that from that distinguished scientific body, the Royal Academy of Sciences at Amsterdam, came a resolution which after discussion at the general assembly of the International Council of Scientific Unions, in April last, led to the appointment of a committee with the following terms of reference:

"The Committee, at suitable intervals, should prepare a survey of the most important results obtained and of the directions of progress that are

opening and of points of view brought forward in the physical, chemical and biological sciences, with reference to:—

"(1) their interconnections and the development of the scientific picture of the world in general; "(2) the practical application of scientific results in the life of the community.

"The work of the Committee is limited strictly to scientific activity." (See *NATURE*, April 24, 1937, p. 697, and May 22, 1937, p. 869.)

This is the concern of the political organization of citizens, including scientists, but not specifically as scientists. In any event, we ought to be careful not to go upon altogether false scents, or set up issues which are too narrow to end the ills from which we suffer. We can go back to bows and arrows but that will not remove the grievances of nations for which they will fight, nor supply the enlightened diplomacy which can keep the peace without injury to a nation's sense of injustice. Do not let us be misled by thinking that the scientist as such can stop war. The military leader can use the triumphs of science to disgrace warfare. That is all. In any event, science cannot cease to follow the exhortation of Carlyle to "Produce in God's name", and it would be bad for humanity generally if it tried. It is not scientific to deal with the offshoots of evil. The scientific method goes to their roots.

Let us face our present conditions in the historical and biological spirit, and much progress in the science and art of applying science to society and government can be recorded. I am familiar with the complaint that the average scientist in Great Britain has been in despair about his difficulty of getting the discoveries of science which directly affect public welfare appreciated by Government. It would be well for Governments to remove this grievance so far as it is sound, and the creation of the Departments which I have mentioned is a start in better conditions and prospects, and is already having a beneficial effect on administration. Still, departmental contacts with science ought to be extended without delay, and India and the Empire—especially the Colonial Empire for which we have more direct responsibility—should not be overlooked, as indeed everyone acquainted with the work of Manson and Ronald Ross knows has not been done.

It must be evident to everyone who has thought about the social consequences of advances in scientific research that they call for a reinvigoration of social science. The experience of later years points out the urgent desirability for close co-operation between the scientist, the industrialist, and the man of affairs, to enrich the lives of human beings, to help such changes as will diminish the disruptive forces in society, and to promote social solidarity which lies at the root of human progress and happiness.

The Biology of Crossing-over

By Dr. C. D. Darlington

SEXUAL reproduction consists of two alternating processes: *fertilization*, by which two germ cells containing each a single set of chromosomes fuse and produce a zygote with the double number of chromosomes, and *meiosis*, by which the double number is reduced and germ cells are again formed with the single number. As Weismann first pointed out, the biological importance of these processes is that they enable the hereditary differences between the chromosomes to be recombined in the greatest number of ways to give the greatest number of different individuals and therefore the greatest scope for natural selection to act in directing evolutionary change.

In recent years we have come to know precisely how this recombination takes place, not merely in one organism, but probably in all sexually reproducing organisms. The method is both more complicated and more efficient than Weismann imagined. In the mother-cells which are to undergo meiosis, the chromosomes are present as single, instead of the usual double, threads of particles. By a combined study of ultra-violet photographs of the particles in

Drosophila, and of the genetic effects of breaking the threads with X-rays at a series of points along their length, the particles have been identified as genes, the atomic units of heredity¹. The chromosome threads correspond, as we should expect, in pairs, and come to lie side by side in pairs, gene by gene. Their attraction is therefore specific. They then coil around one another, and this coiling proves that they have two properties that might well be expected of them. It proves that they are each in a state of torsion such as that which determines the ordinary contraction of a chromosome into a rod-shaped body at mitosis. It proves also that the threads do not slip around one another. They stick together like two threads of wool placed side by side. The attraction of their genes for one another must therefore be specific in position, that is, not merely between the genes but between the parts of the gene².

If we imitate the physical condition of the chromosomes while they are paired and coiled by placing two woollen threads under torsion side by

side, we find that they coil round one another but at the same time necessarily uncoil themselves internally. The relational and internal coiling (as we may call them) are opposite and in equilibrium. The stability of this system is attested by its use in all spinning operations.

The coiling equilibrium of the paired chromosomes is upset by their division, and we then find that the half-chromosomes, or chromatids, arising in this way are as we should expect coiled round one another. But other changes take place at almost the same time as the division and are presumably

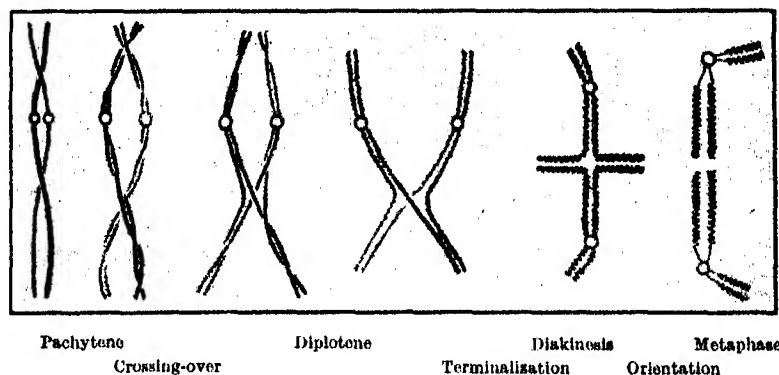


Fig. 1.

DIAGRAM SHOWING THE SERIES OF CHANGES BY WHICH CROSSING-OVER DETERMINES CHIASMA FORMATION AND THE LATER ASSOCIATION, ORIENTATION, AND SEPARATION OF A PAIR OF CHROMOSOMES. THE CIRCLES REPRESENT CENTROMERES OR SPINDLE FIBRE ATTACHMENT CHROMOMERES.

determined by it. First, the divided chromosomes separate: they no longer attract one another. Secondly, chromatids of partner chromosomes break at opposite points and the broken ends uncoil and rejoin so that exchanges of chromatids occur between the separating chromosomes. The chromosomes, although no longer attracting one another, are held together by these exchanges, or chiasmata, which appear in varying numbers and positions in different chromosomes and in different cells.

The special mechanical situation of chromosomes dividing while they are paired thus determines the breakage and reunion which we call crossing-over. In the absence of crossing-over the partner chromosomes fall apart and are unpaired at all later stages. On this process, therefore, the later reduction in number and segregation to opposite daughter-cells equally depend (Fig. 1). Thus crossing-over, which is the only regular genetic change that the chromosomes undergo in their history, is the immediate condition of

reduction and segregation, which are the external changes essential for sexual reproduction. Special exceptions to this rule we will consider later.

Crossing-over within every pair of chromosomes is thus essential to sexual reproduction, but, leaving out this primary consequence, we can sort out its secondary biological consequences into several convenient groups.

First we must take the simple effect of crossing-over in recombining parts of chromosomes, the effect which has been made the basis of genetic analysis in *Drosophila*. Without crossing-over, each chromosome would be a permanent individual, varying and being selected as an individual like a plant clone or any other asexually reproducing organism. With crossing-over, the individual unit of variation and selection will be the unit of crossing-over, which in practice is the gene. Cytological observation has therefore shown that

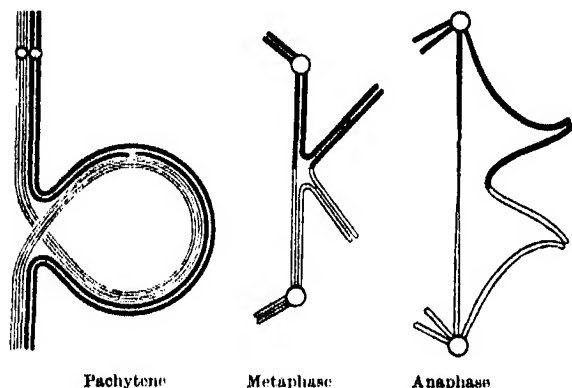


FIG. 2.
DIAGRAM SHOWING THE SERIES OF CHANGES BY WHICH A PAIR OF CHROMOSOMES, DIFFERING IN REGARD TO THE INVERSION OF A SEGMENT, HAVE CROSSING-OVER IN THAT SEGMENT WITH THE CONSEQUENT FORMATION OF ONE DICENTRIC AND ONE ACENTRIC CHROMATID.

the gene structure established by crossing-over experiments in *Drosophila* is applicable to all sexually reproducing organisms. The sizes of the genes and their physiological activity or inertness will be different in different organisms, but their methods of inheritance, variation and selection will be essentially similar. We may expect, for example, that, as in *Drosophila*, chromosomes or parts of chromosomes in which crossing-over is reduced or suppressed will mutate to an inert state in which they will continue until by chance breakage they are lost³.

One respect in which species differ most significantly is in the amount of crossing-over taking place in their whole chromosome complements. This is one factor affecting the amount of total recombination that will take place among the genes at meiosis. The other factor is the number of pairs of chromosomes themselves. By adding

this number to the average total frequency of chiasmata in the mother-cell, we can obtain a *recombination index* which will be a measure of the average total number of independently segregating gene-blocks in the species. This index is 6 in male *Drosophila melanogaster*, 12 in the female, 36 in *Zea Mays* and about 75 in man⁴. It is clear that these enormous differences will affect the character of variation in a species, though in what way it remains for us to find out.

One general property of the recombination index may be noted. A low index has a positive selective value. This may be shown in the following way. The chiasma frequency is under genotypic control; it is therefore capable of selection and is usually as low as is consistent with regular pairing of the chromosomes. On the other hand, it is much easier to increase chromosome numbers, both by doubling individual chromosomes and whole sets, than it is to reduce them. Nevertheless we have to-day a very large proportion of organisms with low chromosome numbers. More than half the angiosperms have twelve pairs of chromosomes or fewer. It follows that while some recombination is a great advantage, too much is a disadvantage. Presumably a certain stability in combination gives the maximum efficiency in the selection of different combinations. In this regard Fisher has remarked⁵ that there is more crossing-over in Nature than would seem desirable. The reason is now clear: each pair of chromosomes has to have at least one chiasma in order to undergo meiosis.

There is another genetic effect of crossing-over that is entirely different from that of recombination; namely, its effect in certain kinds of structural hybrids. Most organisms that have not been closely inbred are structural hybrids of one kind or another. The commonest kind is the inversion hybrid, which has a segment of a chromosome inverted relative to its partner. When crossing-over takes place within such a segment two new chromatids are produced, one joining the two centromeres of the chromosomes and the other joining their two ends and lacking any centromere (Fig. 2). When the bivalent formed in this way attempts to divide, the 'dicentric' chromatid forms a bridge between the daughter nuclei, and the 'acentric' one, incapable of movement, is lost. The bridge may break anywhere along its length, so that new chromatids are produced having some genes in excess and others lacking. Thus the primary structural change of inversion gives rise to secondary changes such as reduplication and deficiency. These are changes of 'balance', and rank with intra-genic changes and position changes as one of the three effective means of variation. The original variation becomes the basis of future variability. This does not mean that variation

within an endogamous group will be cumulative. Equilibrium is presumably reached by the effect of structural change in decreasing fertility, or a new system is established by the breaking up of the group into two smaller genetically isolated groups, that is, by the fission of the species. This property of genetic isolation brings us to the last important relationship of crossing-over.

So long as we have a structurally homozygous stock with crossing-over taking place at intervals between all the varying genes, no stable combination of variants can be maintained without elimination of cross-overs and loss of fertility. Optimum adaptation always demands such a combination, for adaptation depends on the integration of the whole gene system. The most generally recognized way of securing stable combinations is by geographical or ecological isolation. In the same way inter-sterility may secure a genetic isolation of two types of combination. All these methods depend on an isolation of zygotes. But an equally important method is the isolation of chromosomes or parts of chromosomes by structural change. When a small inversion or translocation occurs in one chromosome of a species, crossing-over is restricted or abolished between this changed segment and its normally arranged partner. Any gene differences occurring within this segment are held together in a more or less permanent combination. A new unit, a new order of integration, is established in this way.

It is through this special type of unit that three important types of discontinuity arise in Nature. The simplest type is that by which two groups which remain interfertile diverge within a species. It is probably the basis of the discontinuity between *Avena fatua* and *Triticum Spelta* and their allied forms, which differ essentially in a group of genes lying in a part of one chromosome. A second type is that by which the sex-determining chromosomes (X and Y) come to be distinguished. Originally one pair of genes in these chromosomes determines the sex difference by their segregation. Later other genes become associated with them in two groups which show no crossing-over. Their crossing-over may be suppressed structurally by an inversion or some other similar change. It may also be suppressed genotypically, and here we come to the exceptions in which crossing-over does not take place at meiosis at all. This situation arises in the heterozygous sex in certain insects where a new pairing mechanism is introduced instead of chiasmata. It is only one sex, however, that is affected, and this shows us that in the last resort it is not chiasmata which are indispensable for meiosis but crossing-over which is indispensable for the species. The exclusion of one sex from crossing-over has a special effect on one chromo-

some, the Y-chromosome. Where sex is determined by the segregation of X and Y, the Y, being confined to the heterozygous sex, is permanently excluded from crossing-over. The result of this is shown in evolutionary series when we compare different animals. First the Y becomes inert as in *Drosophila*, later it becomes smaller as in the Mammalia, finally it is lost as in many Orthoptera¹. The intermediate stages show different transitions according to the positions in which crossing-over is localized before its eventual suppression. In whatever way crossing-over may lapse, a group discontinuity arises between the two sex-determining chromosomes. This discontinuity differs in its effect from that arising between species merely in that the two types it distinguishes are mutually adapted for sexual reproduction².

The third type of discontinuity occurs in plants. It is that which arises between chromosomes in establishing a permanent hybrid of the *Enothera* type. Here an interchange of segments between two different chromosomes is the origin of the system. It operates by suppressing crossing-over between the middle segments of the chromosomes, and when all the members of the complement are affected by the interchanges and are held together in a single ring at meiosis, only two types of gamete are produced, and all the chromosomes of one type are prevented from crossing-over with those of the other in their middle segments. Thus complex differences arise owing to the isolation not of zygotes nor of parts of one pair of chromosomes but of parts of all the chromosomes of the gamete, a gametic isolation. The differences between the two gametes are of the same order as the differences between two species.

Other mechanisms occur in the dog roses and with certain kinds of parthenogenesis whereby, as in *Enothera*, a large part of the genes are prevented from recombining. With such systems stability has been achieved at the expense of variability, and we have arrived at what we may call a subsexual method of reproduction.

In these various ways and in many others the study of crossing-over shows us that this simple and universal mechanical property underlies most of the important relationships with which we are concerned in genetics. Variation and adaptation, hybridity and discontinuity, sex-determination and species-formation operate and develop according to the varying occurrence or suppression of crossing-over. Crossing-over is the primary variable in the evolution of genetic systems.

¹ Muller, H. J., and Prokofyeva, A. A., *Proc. Nat. Ac. Sci.*, **31**, 16-28 (1935).

² Darlington, C. D., *J. Genet.*, **31**, 185-212 (1935).

³ Darlington, C. D., "Recent Advances in Cytology" (London, 1937).

⁴ Koller, P. C., *Proc. Roy. Soc. Edin.*, **57**, 194-214 (1937).

⁵ Fisher, R. A., "The Genetical Theory of Natural Selection" (Oxford, 1930).

⁶ Muller, H. J., *Amer. Nat.*, **66**, 118-138 (1932).

News and Views

Sir P. C. Rây, C.I.E.

SIR PRAFULLA RÂY has retired from the Palit professorship of chemistry at the University College of Science, Calcutta, a post which he has held since 1916, and has been elected professor emeritus. His retirement is a noteworthy event in Indian science. The whole of Sir Prafulla's active life has been spent in Calcutta. After receiving his early training in chemistry at the Presidency College under the late Sir Alexander Pedler, he worked for some years in Edinburgh under Prof. Crum Brown, graduating there with the degree of D.Sc. On returning to Calcutta he in due course succeeded Sir Alexander Pedler as professor of chemistry at the Presidency College, where he remained until his retirement from Government service in 1916. Sir Prafulla's own investigations, carried out in collaboration with numerous students, were for many years concerned mainly with the chemistry of the nitrites, to which he made a notable contribution, whilst more recently he has added to our knowledge of thio-compounds and metallic complexes. Sir Prafulla was the first to organize in India a true school of chemistry; he gathered around him a brilliant band of workers whom he imbued with his own enthusiasm for scientific research. Many of these have attained positions of eminence.

THE activities of Sir Prafulla Rây, however, have not been confined within the laboratory walls. He found time to write a history of Hindu chemistry, which has become a classic, and to found, and become honorary director of, a large chemical works, the Bengal Chemical and Pharmaceutical Company. In his later years he has been much interested in political and social questions. His students have for him an extraordinary veneration and affection, which is not surprising since he embodies all that is best of the true Indian "Guru". Outward marks of the esteem in which he is held have not been lacking; he was appointed C.I.E. in 1912 and knighted in 1919. He was president of the Chemistry Section of the Indian Science Congress in 1915 and of the Congress in 1921, whilst he was the first president of the Indian Chemical Society (1924-26). In 1933, in celebration of his seventieth birthday, the Society published a commemorative volume, to which contributions were made by chemists of all nationalities. Into his well-earned retirement Sir Prafulla will take with him the best wishes of all scientific workers.

British Association: Mather Lecture

MR. G. RADFORD MATHER, to whom the British Association owes the foundation of the Radford Mather lecture, is a retired engineer, now living at Wellingborough. Mr. Mather, who combines wide scientific knowledge with a deep appreciation of the necessity for social service, has many and varied

interests. He has given special attention to the study of those forces which govern minimal surface relations, and it was during a correspondence dealing with such matters that the attention of Mr. Mather was directed to the increasing interest shown by the British Association in the repercussions of advances in scientific knowledge on the well-being of the community. Mr. Mather has endowed a triennial lecture, to be given in London or the provinces, to be called the Radford Mather lecture, and to deal, for the most part, with the social implications of the advancement of science. Mr. Ramsay MacDonald gave the first lecture of the foundation, and portions of his address appear elsewhere in this issue. The scientific world is much indebted to Mr. Radford Mather for this foundation, and it is a matter for regret that, in view of his great age—he celebrated the ninety-sixth anniversary of his birthday on October 17—he was unable to be present at Mr. MacDonald's address.

Science and the Community

IN the first Radford Mather lecture of the British Association entitled "Science and the Community" delivered at the Royal Institution on October 22, the Right Hon. J. Ramsay MacDonald paid an eloquent tribute to the value of the scientific method and its broad application to human needs. Science is one of the greatest creative forces of this generation, and the guidance of scientific research is indispensable in treating many of the ills arising in a civilization which is not a static state but one of dynamic energy calling for direction. The most lasting and fruitful of changes are those which arise from the failure or imperfections of existing conditions; discomfort and unrest in the community, like pain in the individual, are danger signals which call for scientific study and treatment. Such pain and unrest may even be preventable by scientific treatment, and while making no plea for the man of science as statesman, Mr. Ramsay MacDonald indicated a wide field in which the scientific method might assist in the development of a rational and broad policy. Health and the home life of the people are two directions in which fundamental changes and advances may be possible in this way, and he suggested, too, that the example of the scientific worker is in itself of value in steadying and clarifying the popular mind not only to complain eloquently but also to conclude wisely.

THE dual plea that the man of science as citizen should take a lively interest in the way his discoveries are used and that the contribution of science to social welfare depends upon an enlightened popular view of the value and significance of these researches and their uses, led to a final plea for a reinvigoration of social science, which is of special interest in view of Lord Nuffield's recent offer to the University of

Oxford for building a new college especially for social sciences. Mr. Ramsay MacDonald claimed that close co-operation between the man of science, the industrialist and the man of affairs is needed to assist the changes which diminish the disruptive forces in society and promote the social solidarity lying at the root of human progress. This reminder of the futility of blaming science and scientific workers for the horrors of war is equally timely. Although science has increased the power which can be applied both to life and to death, peace or war are not the responsibility of men of science as such, and they may well claim that by making war more widespread they have driven home the responsibility for warfare, which lies in the moods of man rather than in his mechanical inventions.

The Evolution of Torpedo Craft

It was but natural that in his presidential address to the Institution of Mechanical Engineers on October 22, Sir J. E. Thornycroft should deal with the development of torpedo craft. He was a child five years of age when at Chiswick his father, Sir J. I. Thornycroft (1843-1928) built the *Lightning*, the first torpedo boat in the British Navy, and he has thus witnessed the growth in size, speed and power of torpedo boats, torpedo boat destroyers and the newest motor torpedo boats. Together with Sir Alfred Yarrow and Jacques-Augustin Normand, of Havre, Sir J. I. Thornycroft was a pioneer of water-tube boilers, forced draught and high-speed engines, and from the works he founded at Chiswick and Woolston have come many of the most notable vessels ever launched. Towards the end of his address, Sir John Thornycroft made some interesting observations on the skimming principle applied to boats, and on the need for simplification in warships. As is well known, the motor torpedo boat, first brought into use in the Great War, is of such a design that when sufficient speed is attained it skims or planes along the surface of the water. Some people think the principle might be applied to larger vessels, but Sir John pointed out that whereas a 50-ft. motor-boat will skim at 30 knots, a 300-ft. destroyer would have to attain a speed of 70 knots, and this would necessitate engines of 200,000 horse-power. Apart from the propelling machinery, ships to-day are filled with mechanism. The very complexity of this raises the question as to means by which it is to be kept in order, and this led to the suggestion that the work of mechanical engineers should be in the direction of simplification.

Co-ordination of Fuel Interests

In his presidential address to the Institute of Fuel on October 14, Sir Philip Dawson traversed the whole range of fuel-producing and fuel-using industries, pointing especially to the leakages and inefficiency resulting from the absence of co-ordination between the different interests. Although the different fuels are to a considerable extent complementary, the system of free competition leads to internecine

conflict, while desirable goals such as the elimination of smoke and the greater production of liquid fuels receive inadequate attention. Such surveys have often been made in the last fifteen years, and Sir Philip comes, like others before him, to the conclusion that the Government should set up a strong central advisory body to co-ordinate the fuel activities of Great Britain. Hitherto, such proposals have passed unheeded, but now he holds that the national interest demands action. Coal should become the raw material for satisfying modern demands in new form. The future requires a smokeless, pure atmosphere in which to live, and suitable solid, liquid and gaseous fuels for every side of national activities.

The Appraisal of Lighting

For the twenty-second Guthrie Lecture before the Physical Society on October 22, Dr. C. C. Paterson discussed "the Appraisal of Lighting". Dr. Paterson pointed out that as techniques have become available during the past thirty years, the art of appraising lighting has changed and advanced greatly. Like so many other subjects, however, that of lighting and seeing has been and is held in check by the inevitable tendency of those who practise it to define it at any epoch in terms of the quantities which they understand. Whereas research can stretch out where it pleases, it is difficult for a practical art to advance faster than the established techniques for appraising its merits. The earliest standard ever adopted, specifying a candle of a certain weight in a lantern, is one which has many advantages and which under a changed form is still probably the most widely adopted. The most easily measured characteristic of a light source is luminous intensity, but a measure which is of more value in estimating the aid to seeing is that of luminous flux. With the advent of differently coloured light sources difficulties of such measurements have grown. The adoption of an internationally accepted relative luminosity curve for the average human eye has brought the measurement of intensity of illumination to a high state of accuracy for sources with continuous spectra. The use of the photocell has added to speed and repetitive accuracy, but not to absolute accuracy.

The measuring of light sources giving a few lines only of the spectrum offers a very much more difficult problem which has been met by the use of sub-standard lamps and carefully selected and calibrated filters. However, with different colours errors creep in. Seeing is fundamentally a matter of contrasts in colour and in brightness, and it is these factors which should be measured. There are several methods of measuring brightness. Photography has been used for registering the effects of lighting on the human eye and recording them permanently on photographic plates. When the brightness of two contrasting surfaces has been measured, we still have no accepted methods of expressing them in terms of their aid to vision. Frichner's fraction, which is an approach in this direction, deals only with threshold values, and our interests lie in values far above those. The new

technique of television offers an opportunity of controlling contrast. Details of the original picture and the reproduced picture at one stage are both held in terms of electrical energy and can be manipulated. With coloured light our problem is not merely to measure colour, but also to measure and specify colour and colour-rendering properties. The colour of light can readily be specified on the I.C.I. trichromatic system, and a rapid technique for indicating the colour of a light source directly on this system has recently been evolved. No standard has yet, however, been set up for the colour-rendering properties of light.

Devil's Dyke, Wheathampstead

THE presentation to the public of land at Wheathampstead, which has been made by Lord Brocket, chairman of the Hertfordshire Society of the Council for the Preservation of Rural England, as a personal gift commemorating the coronation of King George and Queen Elizabeth, preserves as an open space in perpetuity a site which, as has been shown by the excavations of Dr. R. E. Mortimer Wheeler, is of outstanding archaeological and historical significance. For in addition to the four acres of the prehistoric earthwork, known locally as the Devil's Dyke, as Lord Brocket announced in handing over the 999 years' lease to the Wheathampstead Parish Council on October 23, the adjacent area of one hundred acres will also be preserved as an open space under an arrangement he proposes to make with the Hertfordshire County Council and the National Trust. It was here, Dr. Wheeler has shown, that there was situated the fortress, or *oppidum*, of more than a hundred acres in extent, the largest and strongest in Britain as yet known in its period, which was held by the Belgic tribes who had settled in Britain not long before, and of which the capture as the headquarters of the British forces was the climax of the campaign in the second of Caesar's invasions of Britain; while almost immediately after that event, it would seem, it became the parent city of the British stronghold, also excavated by Dr. Wheeler, at Verulamium, which preceded the Roman occupation. The importance of the site for the history of pre-Roman Britain lays a debt of gratitude to the donor for his gift upon circles far wider than those immediately affected by its preservation of local amenities in the future development of the district.

Archaeological Evidence and 'Development'

It is unfortunately only too true that in many instances no private benefactor has been available, nor has public interest been sufficiently strong, to save relics of the past thought by many worthy of preservation, as the Wheathampstead site will be preserved. At the same time, land development and public improvement have not invariably run entirely counter to the interests of the archaeologist. Not only have they brought to light antiquities of which the existence under the surface of the ground was unsuspected, but also on occasion they have made possible archaeological investigations which other-

wise it would probably have been impossible to undertake. The exploration of so large a site as that recently excavated at Colchester would have been difficult, if not definitely impossible, had it not been carried out in conjunction with the making of the new road. It is, however, not only the destruction of antiquities that is to be feared. Among other dangers there is the possibility of serious confusion of evidence which may follow the removal of archaeological material from one area to another. An instance in point is mentioned by Mr. S. E. Winbolt in a communication to *The Times* of October 22, in which he records the discovery of a Roman house in the course of widening a road at Wiggonholt near Pulborough. The soil from this site is being transported by lorry to Pulborough Causeway, two and a half miles away. The discovery was made on the site of cottages called Lickfold (cabbage patch); and in the soil have been found fragments of Roman pottery, Samian and Castor, the foot-ring of a large Samian bowl, and a complete upperstone of a disk quern, fourteen inches in diameter, as well as a mortarium of first- to second-century type. Mr. Winbolt points out that future excavation on the Causeway, which is being widened on both sides, might bring to light Roman material from the Wiggonholt site, which would lead to quite erroneous conclusions as to the relation of the Causeway to Stane Street. Local societies might well be at pains to record any such shifting of material from sites within their respective areas.

British Museum (Natural History): Acquisitions

THE most important recent zoological accession to the Zoological Department of the British Museum (Natural History) is perhaps a collection of mammals and birds made by Messrs. Charles and Edward G. Bird in the Mygybukta region of North East Greenland. The collection is of special interest since it contains examples in breeding plumage and chicks of birds well known in the British Isles in winter, such as the knot, sanderling, turnstone and brent goose. There are also specimens of the ptarmigan in breeding plumage, as well as young birds and small ducklings of the king eider—a rare visitor to Britain. Among the mammals are specimens of the lemming, skulls and skeletons of arctic foxes, and various seals. Another important acquisition to the Department is the mounted head of a chobe situtunga (*Limnotragus spekei selousi*) presented by Major Henry Abel Smith. This rare antelope is known only from about a dozen specimens and enjoys a distribution to the south of the Zambezi between the Chobe Swamps and Lake Ngami in Bechuanaland. Among the accessions to the Department of Entomology is the very valuable collection of butterflies formed by Major P. P. Graves in the Near East, particularly in Palestine, Asia Minor, Syria, the southern Balkans and Greece. This collection is made up of more than 9,000 specimens, and is particularly rich in material from historic localities which were extensively worked by German and Austrian collectors in the middle of the last century.

THE Department of Geology has recently acquired, through the generosity of Mrs. E. M. Reid, a valuable collection of fruits and seeds from the Pliocene of County Durham, Germany and Russia, most of which have been figured by her in the *Journal of Botany* and the *Quarterly Journal of the Geological Society*. In conjunction with M. P. Marty, Mrs. Reid has also presented nearly 700 fruits and seeds from the Pliocene of France. The Department of Botany has been presented with more than seven hundred drawings by the late Dr. A. H. Church. Most of the drawings were made in connexion with the preparation of further volumes of "Types of Floral Mechanism", of which only one volume, that of spring flowers, was published in 1908. A number of the drawings are in colour, but probably those which are of most interest are line and wash drawings of stages in the development of the different floral types. The drawings, accompanied by descriptions and manuscript notes, mostly ready for publication, are probably among the most accurate that have been made. The Department has also received about 900 gatherings of flowering plants and 400 gatherings of lichens and mosses which have been made by C. G. and E. G. Bird in the Mackenzie Bay area of the east coast of Greenland. The collection is well preserved and is valuable as coming from so far north. H. G. Vevers has collected about 500 numbers of flowering plants and cryptogams on the Oxford University Exploration Club's Faroes Biological Expedition. The Museum Herbarium has been so far very poor in plants from this area, and the collection, therefore, is the beginning towards filling an important gap, for many of the forms described appear to be very similar to some occurring in the British Isles, the land nearest to them.

North Pole Station

News from the Soviet North Pole Expedition is given by the Soviet Union Year Book Press Service. It would appear that the floating station is drifting southward towards north-east Greenland. This was to be expected from what is known of the general trend of Arctic currents. Under wind action there are easterly or westerly deviations from this main direction. The drift to the south has averaged 2.35 miles a day since the establishment of the station, and the speed is increasing as the East Greenland Current is approached. During the first month the drift to the south was 84 miles and during the fourth month it was 95 miles. A sounding in the vicinity of the Pole showed a depth of 2,346 fathoms, and it is unlikely that much greater depths occur in the Arctic Sea. The intermediate warm layer of water which Nansen discovered north of Spitsbergen and explained as being saline Atlantic water has been found near the Pole at depths between 12 and 30 fathoms. At a depth of 36 fathoms the water temperature was found to be almost zero, with a steady fall with increasing depth to -0.67°C . at the bottom. It is of interest to note that the inner parts of the Arctic Sea in the vicinity of the Pole are rich in plankton and have much larger animal

life. The floes are even and flat. The smooth floes were, of course, reported by Peary, and did much to facilitate his march to the Pole.

The Indian Oil Industry

ON the whole, the Indian oil industry figures less prominently in the general Press than that of other countries, notably the United States of America. The erroneous conclusion may, therefore, be drawn that methods of exploration, production and refining are not so far advanced in that country as in others. A recent paper by P. Evans (*Current Science*, 5, March 1937), however, clarifies this position by giving a succinct account of modern technique with particular reference to its application to conditions encountered in India and Burma. The main producing oil-fields are at Yenangyaung, Singu and Lanywa in Burma; Digboi in Assam; and Khaur in north-west India. Exhaustive geological mapping has been carried out over a vast area of India and Burma, and maps are available ranging in scale from 4 to 16 inches per mile. Numerous exploratory wells have been drilled, and the fact that the six leading companies in India have spent six crores of rupees on unsuccessful drilling indicates that neither time nor money has been spared in the search for new producing fields. Failure to locate such fields can in no circumstances be attributed to lack of scientific aid, for the help of the geophysicist and the geologist has been freely enlisted in India and Burma. The former has such adjuncts at his disposal as the torsion balance, seismograph, magnetometer and potentiometer; and the latter the aeroplane for field reconnaissance of large areas, the core-drill for putting down shallow-bores to check structure, and laboratory methods of palaeontology, micro-palaeontology and micro-petrology for the examination of core-samples.

IN India, as in most other countries, the rotary drilling system is extensively used for all deep drilling, and such cognate problems as the best type of mud fluid to employ, the accurate diagnosis of strata traversed by the drill, and the prevention of crooked drilling have all been encountered and combatted scientifically by experts. Depths such as those attained in America have not yet been achieved in India, but there are records of wells drilled to more than a mile and a half, and in some cases very difficult territory has had to be negotiated. Though problems of optimum rate of production from individual wells and from fields as a whole are not absent in India and Burma, they are fortunately less acute than in some other countries. This is largely due to the fact that in India the mineral rights, with a few exceptions only, are vested in the State, and in several cases a field is worked by one company alone, while in Burma drilling is regulated by the warden of the oil-fields assisted by an advisory board. The principle of employing competent, fully-qualified geologists, chemists and engineers is followed in both India and Burma, and the technical literature now available as the result of exhaustive research and

correlation of data from the results of past experience on the part both of the oil companies and of the Geological Survey of India is ample testimony of the progress made in the Indian oil industry since its inception.

Lister Institute of Preventive Medicine

At the annual general meeting of the Lister Institute, held on June 2, the Governing Body presented the Institute's forty-third annual report. The report contains an interesting summary of the research work done during the year. Respecting viruses, a team of workers has continued the study of a possible virus agent in the causation of acute rheumatism and rheumatic diseases, Dr. Salaman has continued his investigation of the antigenic structure of vaccinia virus, and Sir John Ledingham has studied the peculiar relationship that exists between the filterable viruses of rabbit myxomatosis and rabbit fibroma. Dr. Felix and Miss Pitt have continued their investigations on the antigenic constitution of the typhoid bacillus, and on the virulence and immunizing properties of bacteria. Much work has also been carried out on vitamins and nutrition, and Prof. Robison has continued his studies on calcification. The two Svedberg ultracentrifuges, provided by a grant from the Rockefeller Foundation, have proved satisfactory, and have been used in the investigation of virus bodies and of proteins. The National Collection of Type Cultures, housed at the Institute, has distributed during the year some 5,000 cultures, and 200 new strains of micro-organisms have been added to the Collection.

The Night Sky in November

THE moon is new on November 3 at 4^h and full on November 18 at 8^h U.T. On November 20, the moon occults the 3rd magnitude star ζ Tauri, the disappearance as seen from Greenwich taking place at 5^h 33^m and the reappearance at 6^h 28^m. On November 21, ν Geminorum (magnitude 4.1) is occulted, the reappearance being observable at Greenwich at 0^h 8^m. Conjunctions of the moon with the planets occur as follows—Venus on November 1^d 8^h: Jupiter on November 9^d 7^h: Mars on November 9^d 21^h: Saturn on November 14^d 16^h. On November 4, Uranus is in opposition to the sun; on this date the planet may be located between α Arietis and ω Arietis, stars of about the same apparent magnitude as that of Uranus, which presents a small disk of about 3 $\frac{1}{2}$ " in diameter. Both Jupiter and Mars are low in the early evening sky, but Saturn, southing at about 20^h in the middle of the month, is better placed for observation. Venus is a bright morning star and is near Spica (α Virginis) on November 6. The variable star Algol (β Persei) is well placed for observation throughout the night. The change in light may be easily seen about 1 $\frac{1}{2}$ hours before and after the following times: November 10^d 2.2^h, 12^d 23.0^h, 15^d 19.8^h and 30^d 3.9^h. The Leonid meteors are expected between November 9 and 20, the radiant point being about 10° north of the bright star Regulus. The maximum of the

Andromedids is due about November 20, the radiant being near γ Andromedæ. By midnight in mid-November, the brilliant collection of our winter stars comprising those of the constellation of Orion, preceded by Aldebaran and the Pleiades and followed by Procyon and Sirius, is well above the eastern horizon.

Announcements

DR. GÜNTHER JUST, director of the Institute of Genetics at the University of Greifswald, has been appointed director of the corresponding institute of the Health Office of the Reich at Berlin-Dahlem.

At the annual statutory meeting of the Royal Society of Edinburgh, held on October 25, the following Council was elected: *President*: Sir D'Arcy Wentworth Thompson; *Vice-Presidents*: Prof. F. A. E. Crew; Lieut.-Colonel A. G. McKendrick; Principal J. C. Smail; Prof. J. Walton; Dr. James Watt; Prof. E. T. Whittaker; *General Secretary*: Prof. James P. Kendall; *Secretaries to Ordinary Meetings*: Dr. A. C. Aitken and Dr. C. H. O'Donoghue; *Treasurer*: Dr. E. M. Wedderburn; *Curator of Library and Museum*: Dr. Leonard Dobbin.

PROF. M. POLANYI writes with reference to his article on the recent international scientific meeting at the Palais de la Découverte (NATURE, Oct. 23, p. 710): "In my article on the International Congress in Paris reference is made to a conversation with German delegates. This statement originates from an editorial correction of the manuscript. My own report stated that the remarks on a better understanding between German and French peoples were made at the opening meeting." Prof. Polanyi's original words, to the editorial modification of which he refers, were as follows: "Later in the evening I noticed a spy thrusting himself into my conversation with one of the German delegates. The German spoke about a better understanding of the German and French people—three delegates using the same, no doubt officially approved, phrase."

THE Oxford University Press announces that the treatise on the "Science of Petroleum", under the editorship of Dr. A. E. Dunstan, Prof. A. W. Nash, Sir Henry Tizard and Dr. Benjamin T. Brooks, will be published in December or January. It has been decided to issue the work in four volumes, instead of three, as previously announced. The preparation of a Supplementary Volume, with accounts of work which has appeared while the treatise has been in the press, is under consideration.

ERRATUM.—In the paragraph, based on Dr. J. Needham's Herbert Spencer Lecture, and entitled "Organization of Human Society", which appears in NATURE of October 16, p. 679, there is a sentence which reads: "He suggests that a democracy which produces is the form of society most in accord with what we know of the biological basis of human common life." The word "experts" should have been printed after the word "produces".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 774.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Spontaneous Chromatin Rearrangements in *Drosophila*

SPONTANEOUS chromosomal rearrangements are considered to be rare in *Drosophila*. (Pale and blond are the known cases.) During the past few years I have found two new cases of considerable interest, the detailed analysis of which was delayed by external circumstances. Both cases occurred in pedigree and closely watched cultures, the abnormal broods being among numerous identical normal ones.

The first case started with an uncontrolled change of a standard plexus culture, which began to exhibit an extreme plexus character with blisters on one wing. It was found that here a 'mutation' to an allele of blistered had been added to the plexus stock. In studying some interesting peculiarities of this line, another change occurred. After this had happened, the plexus-blistered line was examined more closely, and it was found that the change to blistered had already entailed a rearrangement involving at least the additional loci white, echinus, rudimentary and extreme left end of the first chromosome. The new rearrangement resulted in the simultaneous appearance of the original plexus, of wild type, of rudimentary, identical with the classic one and of a recessive type 'mutant' with pointed wings, at the left end of the first chromosome. Also what seems to be an ebony allele appeared and a few less viable forms with spread plexus-blistered wings, or with only blisters. The analysis of the rather complex details is nearing completion.

The second case is still more remarkable. In one of numerous crosses of wild type and blistered a rearrangement occurred which involved, as it seems, only a second chromosome. This rearrangement produced simultaneously with the disappearing of blistered, the appearance of (1) dumpy, identical with the classic one; (2) vortex-thoraxate, the same; (3) purple, the same; (4) a plexus-like form still to be localized; and (5) a recessive 'mutant' with folded soft wings. Thus three well-known 'mutants', and possibly five, were produced as the result of an intra-chromosomal rearrangement.

It is remarkable that in both these cases the rearrangement hit a whole brood, thus indicating its occurrence in primordial germ cells.

These facts and others not yet ready for presentation, as well as the results of other workers, have convinced me—as repeatedly expressed in lectures within the past three years—that the time has come to acknowledge that gene mutations have as little existence as genes themselves. (A number of geneticists

have already played with this idea, but hesitated to drop the old conception of the gene. They took refuge in position effects and mutations near the locus of a break.) The idea of a position effect, made to save the gene concept, will also have to disappear when it is recognized that the position effect is actually identical with what was called a gene. The chromosome as a unit will be found to control normal development or wild type. The changes of the correct order within its chain produce deviations from normal development, called mutants. Though they are localized, there is no such a thing as a gene and certainly no wild type allelomorph. Details will be published later.

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Sept. 27.

Ionization by Radioactive Gamma and Cosmic Rays in Different Gases

THE ionization by radioactive gamma and cosmic rays in different gases has been investigated by V. Masuch¹ since 1932 and by me since 1936². For all measurements we used the same Kolhörster apparatus, the zero of which was separately determined at a depth of 406 m. in the Berlepsch salt mine of Stassfurt.

The effects of a radium C gamma ray source, filtered by 6 mm. of lead, of cosmic rays filtered by 5 cm. and 10 cm. of lead and of the penetrating radiation (unfiltered cosmic rays plus radium C gamma rays from soil and free air) gave the results shown in the accompanying table.

	Density	Penetrating radiation	Cosmic rays		RaC γ -rays*	
			5 cm. lead filter	10 cm. lead filter	Our measurements	Ziemeckl
He	0.0001787	0.50 I	0.30 I	0.26 I	1.00 I	
Ne	0.890	2.40	1.29	1.27	4.25	
Ar	17629	4.89		2.45	8.51	7.55 I
Kr	3645	10.52	5.46	5.13	19.4	20.1
Xr	572	21.25	8.77	7.83	31.9	
H ₂	0.08985	0.31		0.14	0.89	
N ₂	12508					3.70
Air	12928	2.91		1.60	5.08	
O ₂	14292	3.23	1.88	1.78	5.82	
CO ₂	19768				8.70	

* On an arbitrary scale.

In Fig. 1 the ratio ionization/density is plotted as a function of the density of the gases concerned.

The ionization is directly proportional to the density of the gases only in the case of the hard components of the cosmic rays at sea-level. With softer components the curves bend more and more. The effect

of ionization by radioactive gamma rays is therefore different from that by cosmic radiation at sea-level, so much so that this behaviour may be utilized in distinguishing between gamma and cosmic rays¹.

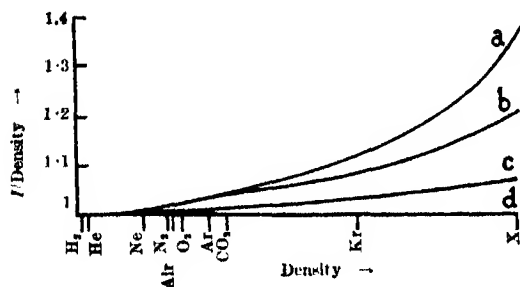


Fig. 1.

THE RATIO $I/\text{Density}$ PLOTTED AGAINST DENSITY. *a*, UNFILTERED PENETRATING RADIATION; *b*, RADIUM C GAMMA RAYS FILTERED BY 6 MM. LEAD; *c*, COSMIC RAYS FILTERED BY 6 CM. LEAD; *d*, COSMIC RAYS FILTERED BY 10 CM. LEAD.

A short time ago Ziemecki⁴ gave the following results for the ratio of ionization by radioactive gamma rays in nitrogen, argon and krypton to air:

$$I_{N_2} : I_{Ar} : I_{Kr} = 0.49 : 1 : 2.66;$$

while the densities are

$$\rho_{N_2} : \rho_{Ar} : \rho_{Kr} = 0.77 : 1 : 2.06.$$

These data for argon and krypton at 12 atm. agree with our results for one atmosphere ($I_{Ar} : I_{Kr} = 1 : 2.28$) showing the same behaviour. However, Ziemecki believes the effects of ionization by gamma and cosmic rays to be roughly proportional. Our numerous measurements show only the hard components of the cosmic radiation at sea-level causing ionization in the ratio of the density of the gases examined.

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Sept. 15.

¹ Masuch, V., *Z. Phys.*, **79**, 264 (1932).

² Jullifs, J. and Masuch, V., *Z. Phys.*, **104**, 458 (1937).

³ Jullifs, J., *Phys. Z.*, **38**, 691 (1937).

⁴ Ziemecki, St., *NATURE*, **140**, 150 (1937).

Two Spectrometers for X-Ray Analysis

SOMETIMES a conical camera has been used to obtain good pictures of high-order layer-lines from a rotating crystal, the angle of the cone in most cases being about 60° or 90° .

In several respects this method is awkward. By making that angle 180° , the difficulties will be less; the camera becomes more simple, the film easier to handle, and the identification of reflections will be more readily surveyed, every layer-line being a circle. Only the 0- and perhaps one or more of the lower order layer-lines will be missing on that photograph.

It is possible to take a photograph on a stationary film and on a moving film at the same time. Another possibility is to couple the movement of the film in some manner to that of the crystal, for example, by moving the film parallel to the crystal rotation axis (but not around that axis). In this way it will

always be possible to assign the appropriate indexes to the spots on the film.

A simple camera design of this type is shown in Fig. 1; a circular stationary film, *a*; another film at the same distance from the crystal, but rotating with the crystal, *b*; whereas the 0-layer-line is recorded on a narrow cylindrical film, *c*.

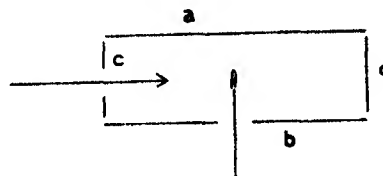


Fig. 1.

For the investigation of powders it may be advantageous to use a camera with the film cylinder having the same axis as the X-ray beam (see Fig. 2). The reflected beams, lying on cones, will cut the cylindrical film in circles; when spreading out the film after developing, the picture of straight lines will resemble a diagram taken with an ordinary optical spectrograph. Especially for purposes of identification, as well as for back-reflection X-ray

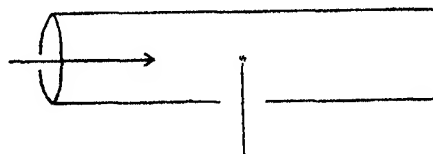


Fig. 2.

photographs, the method described may be useful. Taking a series of exposures on the same film, a narrow strip may be taken parallel to the primary beam. In that case a flat film or plate can be used.

I am indebted to Prof. Ir. J. A. Grutterink, who enabled me to design the cameras described.

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Sept. 20.

Spacing of the Resonance Neutron Levels of Silver, Rhodium and Bromine Nuclei

FROM recent work on group and thermal neutrons¹, the constants describing the resonance absorption of an element can be calculated fairly accurately. This simplifies the estimation of the average spacing of the resonance neutron levels in the experiment of Chao and Fu² and makes it possible to work with a thinner paraffin scatterer so as to obtain a beam of neutrons distributed more uniformly over the energy spectrum. We have now made measurements with a paraffin scatterer of only 2 mm. thickness. The neutron source consisted of 100 mgm. radium surrounded with 12 gm. beryllium, and the scatterer in the form of a spherical shell was of 4 cm. outer diameter. Detectors of silver, rhodium and bromine, approximately 3 cm. \times 3 cm. in size, were exposed at a distance of 1.2 cm. from the paraffin, and the induced activity was measured with a Geiger-Müller counter.

Let the neutron capture cross-section due to the existence of a single resonance level be written as

$$\sigma = \frac{A}{E^{1/2}(\Gamma^2 + (E - E_r)^2)}$$

where E_r and 2Γ are the energy and half width of the level, both to be expressed in volts. Then the ratio of the capture cross-sections of the resonance and thermal neutrons with self induction is given by

$$\sigma_r : \sigma_c = \frac{A}{2E_r^{1/2}\Gamma^2} : \frac{A\pi^{1/2}}{(0.026)^{1/2}E_r^{1/2}} = \frac{(0.026)^{1/2}E_r^{1/2}}{2\pi^{1/2}\Gamma^2}$$

This formula when applied to the capture cross-sections of the group and thermal neutrons, should give an approximate value of Γ and hence of A , except in the case where the first negative resonance level is closer to zero energy than the first positive level (as might be the case of bromine).

Let E_0 be the upper limit of the continuous spectrum of the neutrons scattered from paraffin, N_0 the number of scattered neutrons received by the detector per volt energy range and per second, μ the absorption coefficient of the β -rays per atom of the detector, and n_1 the average density of the resonance levels per volt. Assuming Γ and A to be constant for the resonance levels located in the continuous neutron spectrum, we can easily deduce the following approximate expression³ for the total number of β -rays given in one second by a thick detector in the saturation state:

$$\Sigma N = \frac{N_0 \pi A n_1 E_0^{1/2}}{\mu \Gamma}$$

To calculate N_0 , we make the photo-electric cross-section of beryllium nuclei equal to 2×10^{-28} cm.², the proton-neutron scattering cross-section equal to 10×10^{-28} cm.² and E_0 equal to 1.42×10^6 v. Knowing Γ , A , E_0 and N_0 , we can evaluate n_1 from the measured values of μ and ΣN . Various quantities used in our calculation are collected in the following table, where column Δ gives the average spacing of the resonance levels, all referring to the short period. For Ag, the second value is obtained with a thin detector of surface density 0.06 gm./cm.².

	$\sigma \times 10^{24}$	$\sigma_c \times 10^{24}$	E_r	Γ	$A \times 10^{14}$	$\mu \times 10^{14}$	$N_0 \times 10^5$
Ag	3560	535	2.5	0.062	30.5	1000	2.5
Ag							
Bh	680	102	1.2	0.095	13.5	1000	2.0
Br*	740	7.3	62	0.42	2050	1200	2.1

* Neutron absorption coefficients of this element determined by T. H. Wang.

The values of Δ here obtained are seen to be in good conformity with the location of the ordinary neutron groups. It is, however, to be noted that the present calculation is based on various cross-sections which are only known approximately, and it can be further improved when the accuracy of these quantities attains a higher degree.

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July 27.

Changes of Colour by Injection of Pituitary Extracts in a Dogfish (*Scylliorhinus canicula*)

INJECTIONS of pituitary extract were performed on an exceptionally light-coloured dogfish obtained in the Aquarium at Dinard in August 1937; in this fish the usual large patches were very faint, and so were the small spots or maculae. At a distance of ten yards from the tank, the lack of colour of the integument made the animal very easily distinguishable from its fellows. The condition could not properly be described as albinism, the pigment not being altogether lacking: apart from a certain amount of pigment, faintly but evenly extending over the whole of the back, there was a dark spot, about one third of an inch in diameter, behind and above the right gills. With the exception of the pallor of the skin, this male fish was quite similar to the others in size and shape.

The extract used (Post-hypophyse Choay No. 4) contained half of the posterior lobe of ox-pituitary per c.c. and the injections were made intraperitoneally.

RESULTS

The first injection (0.25 c.c.) was without apparent effect.

The second injection (0.7 c.c.) caused the following changes: 15 minutes after—a slight darkening of the skin; 30 minutes after—a very distinct darkening: the patches appeared sharply, the spots became darker, the fish could only be distinguished from the others by a mark made on the fin, its colour being as dark as that of the nine or ten normal fish in the tank; 3 hours after—condition unchanged; 18 hours after—the fish had almost resumed its original whitish colour.

The third injection (1 c.c.) gave exactly the same results.

A control injection was then given of 1 c.c. of seawater: it did not influence the colouring in the least.

The fourth injection of the same pituitary extract was then made (1 c.c.). The darkening was as great as before, but lasted only about three hours.

A fifth similar injection (1 c.c.) produced darkening which lasted twenty to twenty-two hours.

At that stage an injection of anterior lobe of pituitary was tried (0.5 c.c.) of an extract containing 0.25 gm. of gland per c.c. (Zoo-Antelobyl Roussel). It gave no results.

An injection of another brand of posterior lobe extract (Zoo-Postlobyl Roussel) containing 5 International Units per c.c. was given and the results were:

First injection (0.5 c.c.) (2.5 International Units)—10 minutes after—the fish was getting darker; 30 minutes after—the fish became indistinguishable from the others in the tank; 3 hours after—original colour nearly restored.

Second injection (1 c.c.): Same results but more lasting (12 hours).

Forty-eight hours after this last injection, the fish died, without having quite resumed its original colour: possibly the last dose of hormone had been too great.

A constant reaction to all the injections of posterior lobe extracts, especially at the beginning of the absorption period, was an increase in the rate of breathing: 70-80 respirations per minute, instead of 50-60 normally.

The post-mortem examination showed, first of all,

¹ Amaldi and Fermi, *Phys. Rev.*, 50, 899 (1936); Goldsmith and Rasetti, *Phys. Rev.*, 50, 523 (1936); Breit and Wigner, *Phys. Rev.*, 49, 519 (1936); Bethe and Placzek, *Phys. Rev.*, 51, 450 (1937).

² Chao and Fu, *Chinese J. of Phys.*, 2, 135 (1936); *NATURE*, 139, 325 (1937).

³ This formula can be obtained from formula (12) of the paper in *Chinese J. of Phys.* by neglecting the long factor.

that a severe wound which the fish had received from a metal fitting in the tank, four or five days previously, had left a fairly deep cavity filled with blood-clot, completely destroying the right spiracle and surrounding area.

The organs seemed to be quite normal except the gall-bladder, which had apparently been perforated by the injection needle.

The base of the brain revealed a peculiar type of pituitary body. The ventral, nervous lobe, with its connecting stalk and infundibulum, seemed slightly smaller than usual in this fish; the vascular body (situated dorsally to the nervous lobe, between it and the brain) was smaller than usual, displaced laterally and seemed to be grafted on to the right angle of the optic chiasma. In the normal fish, the two lobes are in contact, but can easily be separated. In this one the gap was evident.

Histologically, both lobes appeared normal, but in the vascular body chromophobe cells tended to prevail.

No trace of traumatic lesion of the roof of the mouth was found, and the aspect of the gland seemed to point to a congenital condition.

The congenital malformation of the gland might explain the insufficiency of the pigmentary system merely by lack of its development, or perhaps the gap between the two lobes prevented proper circulation between them.

The fish reacted to the posterior pituitary extract in the same way as the hypophysectomized fish, as observed in successful operations performed on normal dogfish during the course of injections mentioned.

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Self-arrangement in the Mitotic Spindle under Mechanical Influence

IN a previous communication¹ it was pointed out that in all types of protoplasm hitherto used, fibrils or linear units are really present, although only visible if the protoplasm is flowing through the capillary of a deformation apparatus.

The following are more recent observations concerning the appearance of the mitotic spindle fibres after mechanical gelation of the anaphasic nucleus. No traces of spindle fibres are to be seen at any stage of mitosis in living connective tissue cells cultivated *in vitro* under the usual conditions². But they become visible as soon as acid is added (M. R. Lewis), or when a similar gelation is brought about by means of a gentle rapping or pressure of the culture (J. Ellenhorn³ on living cells of *Tradescantia*), or by a stretching of the jelly film of the culture spread out within a little glass frame (H. H. Pfeiffer). All recent evidence supports the view that the spindle is a comparatively rigid structure. Experiments of R. Chambers show quite clearly that it is like an elastic gel capable of considerable mechanical distortion.

It is generally assumed that the energy for movement of the daughter chromosomes towards the poles is derived either from the spindle, the fibres of which are looked upon as contractile fibrillae (*Zugfasern*), or from a body driving asunder the chromosomes (*Stemm-körper*). The spindle fibres have been proved to exist

as positively doubly refractive bodies between crossed nicols⁴. Such a phenomenon cannot occur except by a flowing or pulling process. Therefore, W. J. Schmidt supports the hypothesis of contractile pulling, and compares the spindle fibres with other contractile fibrillae of protein nature showing positive double refraction⁵. This comparison, however, may not be valid, because the anaphasic chromosomes moving towards the pole intersect the spindle fibres in spite of their rigidity. From observations between crossed nicols it seems correct to conclude that the spindle fibres arise in a similar way to Zocher's tactoids⁶. In the geloid stage of the mitotic nucleus the anisotropic particles may approach each other owing to a dehydration process, but the contractibility of the fibres does not explain the mechanism of the movement of chromosomes.

From a theoretical point of view, there is a number of interesting problems involved in the physics of a dividing cell nucleus, and I hope to give a detailed communication of my experiments at the Fifth International Congress for Experimental Cytology at Zurich. At present I wish to show that, owing to a weak mechanical influence, in the nucleus of mesenchyme cells of *Salamander* embryos cultivated *in vitro*, distinct spindle fibres with positive double refraction arise and give further evidence for anisotropic and linear structure within the cell.

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Sept. 29.

¹ Pfeiffer, H. H., *NATURE*, **138**, 1054 (1936); *Cytologia*, Fujii Jubil. vol. (1937); *Verh. deutsch. zool. Ges. Bremen*, 106 (1937).

² Fischer, Alb., "Gewebezüchtung", 3. Aufl. (München: R. Müller u. Steinicke, 1930); Levi, G., *Erg. Anat. u. Entw.gesch.*, **31**, 125, 316 sq. (1934).

³ Ellenhorn, J., *Z. Zellf. u. mikr. Anat.*, **20**, 288 (1934).

⁴ Schmidt, W. J., *Biodynamica*, **22** (1936).

⁵ Schmidt, W. J., "Die Doppelbrechung von Karyoplasma, Zytoplasma und Metaplasma", p. 121 sq., 251 (Berlin: Gebr. Borntraeger, 1937).

⁶ Zocher, H., *Z. anorg. Chem.*, **147**, 91 (1925); Freundlich, H., Enslin, O., und Seeliger, K., *Protoplasma*, **17**, 489 (1933).

Interaction between Cell Nucleus and Cytoplasm

THE assumption has been made frequently that the genes exert their effects upon the cytoplasm during the 'resting' stage of the cell. This implies that nuclear end products of genic reactions can pass through the nuclear membrane or at least react with cytoplasmic components at the nucleocytoplasmic interphase. However, no explicit demonstration of this assumption has been given as yet. On the other hand, it has been proposed, again without proof, that the genic end-products in the nucleus are released into the cytoplasm during the mitotic breakdown of the nuclear membrane only.

It is the purpose of this note to indicate that the two opposing views can be tested and that data are available for a decision. If the genetic constitution of a cell is changed, and if a cytoplasmic effect of the new constitution becomes apparent in this single cell before nuclear division has occurred, it is obvious that the gene concerned has interacted with the cytoplasm during the resting state of the nucleus. If, on the other hand, the cytoplasmic effect of a changed genetic constitution becomes visible only after nuclear division and in the two ensuing daughter cells, then the conclusion is suggested that the disappearance of the nuclear membrane is necessary

for the release of the gene-dependent substances. Changes in genetic constitution occur in somatic tissues as the result of mutations or of chromosomal processes like segregation, non-disjunction, etc.; and in germ cells as the result of recombination of genes during the maturation divisions.

An analysis of the few cases in which genetically determined characters can be observed in single cells, in *Delphinium*, *Zea Mays*, the smut fungus *Ustilago* and *Chlamydomonas*, indicates that specific genes can interact with the cytoplasm during the resting state of the nucleus. These genes are concerned in the production of anthocyanes, of specific sexual reactions, and of different morphological characteristics. Further work undoubtedly will increase the number of known cases. It remains to be seen whether examples will be found in which gene-controlled substances exert visible effects after the breakdown of the membrane only, as is possible in some cases of pollen dimorphism.

A more complete discussion of the data will appear in the *American Naturalist*.

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Action of Pancreatic Extract on Fatty Liver

Kaplan and Chaikoff¹ have shown that the fatty infiltration of the liver in depancreatized insulin-treated dogs can be inhibited by the addition of raw pancreas to the usual diet. Dragstedt² and his co-workers then showed that the active factor can be extracted from pancreas by the aid of alcohol. In conjunction with these investigations, we sought to answer the following two questions: (1) whether in normal rats the fat content of the liver can be influenced by a diet of pancreas; and (2) whether a variation in the fat content of the liver is linked with a variation of the carbohydrate content.

Pancreatic extracts were prepared by a method almost identical with that of Dragstedt. Each rat received a quantity of extract per week corresponding to 100–150 gm. of fresh pancreatic tissue.

In normal fed rats (20 per cent casein, 70 per cent starch, 10 per cent fat), no definite differences in the fat content of the liver were evident when the pancreatic extract was added to the diet. When, however, a fatty liver had been produced by diet, an average decrease from 12.8 per cent liver fat content to 5.2 per cent was obtained by administration of pancreatic substance in fourteen experiments. The nutrition period lasted 6–14 days and in two cases 30 days. The diet was as follows: saccharose 45 per cent, butter fat 40 per cent, casein 5 per cent, marmite 5 per cent, salt mixture 5 per cent (Channon³).

Extracts of spleen, brain or liver prepared in exactly the same fashion and fed in the same manner were generally without effect or very much weaker (liver) than those of pancreas. No uniform differences in fat and sugar content of the blood or in the excretion of total acetone bodies were observed as between control rats and rats treated with extract. If the quantity of acetone bodies is assumed to be a measure of fatty acid oxidation, it must be concluded that the pancreatic extract under consideration is without effect on fat oxidation. This conclusion is supported by the fact that in the two experiments of longest duration, no less body fat was found in rats treated

with pancreatic substance than in the control animals. The weights in the treated animals were in general better maintained than in the controls.

As regards the second question, it can be stated that in conjunction with the decrease of fat content of the liver of treated animals no increase of glycogen content could be established in our brief experiments, so that for our conditions at all events the antagonism between fat and glycogen in the liver does not exist. Experiments in this connexion extending over longer periods will be reported later.

It is clear that the rat method possesses great advantages in the investigation of the pancreatic substance. This substance could not be demonstrated in the outer medium after extended dialysis through parchment membranes. Positive results could be obtained, however, after a brief period of dialysis through 'Cellophane' and cuprophane. A strongly positive effect is obtained with pancreas autolysate. It is not quite clear as yet, however, if this effect is absolutely specific. The question whether the active principle in pancreas is choline (Best) has to be clarified. The fact that the quantity of choline necessary according to Best could not have been contained in the quantities of extract fed by us is against this conclusion, as is also the ineffectiveness of extracts of the other organs mentioned. Moreover, choline is adsorbed by Lloyd's reagent and can be eluted by barium hydroxide. These tests failed with the pancreatic substance under consideration.

After the experiments here reported had been concluded, a paper was published by Eaton M. MacKay⁴, in which the rat method for the demonstration of the action of pancreas on liver fat was used. His results are consistent with ours.

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Sept. 16.

¹ Kaplan, A., and Chaikoff, J. *Biol. Chem.*, **108**, 201 (1935); **119**, 435 (1937).

² Van Prohaska, L., Dragstedt, L. R., and Harms, H. P., *Amer. J. Physiol.*, **116**, 122 (1936); **117**, 166, 175 (1936).

³ Channon, H. J., and Wilkinson, H., *Biochem. J.*, **30**, 1033 (1936).

⁴ MacKay, E. M., *Amer. J. Physiol.*, **119**, 783 (1937).

Specific Action of Ferricyanide on Aerobic Glycolysis of Tumour Cells

It has been found¹ that ferricyanide (10^{-3} mol./litre) stops aerobic glycolysis of mammalian tumour cells, but it does not affect anaerobic glycolysis of any cell in mammals. In this respect, ferricyanide differs fundamentally from all other substances which have been found to check glycolysis (fluoride², moniodoacetic acid³, glyceric aldehyde⁴).

Ferricyanide is reduced by tumour cells, probably combining with and inactivating some part of their glycolytic system. The action of ferricyanide outlasts the time of its application: tumour cells once deprived of their aerobic glycolysis by ferricyanide do not glycolyse aerobically for many hours if kept in a medium no longer containing ferricyanide.

In order to find out whether the action of ferricyanide would be restricted to glycolysis of tumour cells and thus be specific, experiments were done with medulla of kidney, which has been found⁵ to be the only normal mammalian tissue with aerobic glycolysis. Rat, cat and guinea pig kidneys were used. In no case did ferricyanide check the aerobic

glycolysis of kidney medulla; in some experiments aerobic glycolysis was even stimulated slightly by ferricyanide. Glyceric aldehyde, on the other hand, was found to inhibit both aerobic and anaerobic glycolysis in kidney medulla as it does in tumours⁴.

These experiments (see Tables 1 and 2) were carried out with O. Warburg's manometric method⁵, the results being controlled by chemical determination of lactic acid⁶.

POTASSIUM FERRICYANIDE

	Mol./litre	O ₂ Q CO ₂	N ₂ Q CO ₂
Medulla of kidney (rat)	0 10 ⁻³	10.5 12.8	28.7 29.5
do. (rat)	0 10 ⁻³	11.7 12.4	28.6 28.2
do. (cat)	0 10 ⁻³	15.7 16.1	
do. (guinea pig)	0 10 ⁻³	14.2 15.3	19.7 20.5
Balogh tumour (mouse)	0 10 ⁻³	22.1 2.8	28.9 27.5

d,l-GLYCERIC ALDEHYDE

	Mol./litre	O ₂ Q CO ₂	N ₂ Q CO ₂
Medulla of kidney (cat)	0 2 × 10 ⁻³		14.6 1.9
do. (rat)	0 4 × 10 ⁻³	14.2 2.3	
Balogh tumour (mouse)	0 2 × 10 ⁻³ 4 × 10 ⁻³	10.9 3.7	32.3 2.8

Ferricyanide thus seems to act exclusively and specifically on aerobic glycolysis of mammalian tumour cells.

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Sept. 17.

¹ Mendel, B., *Angew. Chemie*, **46**, No. 2 (1933). *Amer. J. Cancer*, **30**, No. 3 (1937).

² Diokens, F., and Simer, F., *Biochem. J.*, **23**, 936 (1929).

³ Lundsgaard, E., *Biochem. Z.*, **217**, 162 (1930).

⁴ Mendel, B., *Klin. Wochenschr.*, **8**, 169 (1929).

⁵ György, P., Keller, W., and Brehme, Th., *Biochem. Z.*, **200**, 366 (1928).

⁶ Diokens, F., and Well-Malherbe, H., *Biochem. J.*, **20**, 559 (1936).

⁷ Warburg, O., "The Metabolism of Tumours". (Constable and Co., London, 1930.)

⁸ Mendel, B., and Goldscheider, T., *Biochem. Z.*, **164**, 163 (1925).
Mendel, B., *Biochem. Z.*, **202**, 390 (1928).

Oestrogenic Activity of some Hydrocarbon Derivatives of Ethylene

In an earlier preliminary communication¹, we reported the activity of some substituted derivatives of ethylene including the hydrocarbon diphenyl ethylene (stilbene). Before making any further publication, we decided to investigate other hydrocarbons of the same series as extensively as possible.

Robson and Schönberg², however, have since reported the activity of triphenyl ethylene, and as these workers made no reference to the communication in which we initiated this series of oestrogenic substances we feel that the full publication of the series now completed will be of interest. The following table shows our results.

Substance	Dose (mgm.)	Percentage Positive
Styrene	100	Nil
Propenyl benzene	100	Nil
Stilbene	25	100
α : α-Diphenyl ethylene	100	Nil
Triphenyl ethylene	10	100
	5	50
Tetraphenyl ethylene	25	Nil
α : β-Di-1-naphthyl ethylene	25	Nil
α-Methyl stilbene	25	Nil
α : γ-Diphenyl propylene	25	Nil
β-Methyl-α : γ-diphenyl propylene	25	Nil
α : δ-Diphenyl butadiene	25	100

The long duration of oestrus and the induction of mating are usually associated with this type of compound. Working with substances supplied by us, Hemmingsen and Krarup³ have demonstrated mating instincts of high degree in the ovariectomized rat and enhanced spontaneous muscular activity, whilst Wolfe⁴ has shown that our substances are capable of preventing the development of castration cells in the anterior lobe of the pituitary.

E. C. DODDS.
M. E. H. FITZGERALD.
WILFRID LAWSON.

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Middlesex Hospital, W.1.
Oct. 13.

¹ Dodds, E. C., and Lawson, W., *NATURE*, **139**, 627 (1937).
² Robson, J. M., and Schönberg, A., *NATURE*, **140**, 194 (1937).
³ Hemmingsen, A. M., and Krarup, N. B., *Det kgl. Danske Videnskabsn. Selskab., Biol. Med.*, **13**, 8 (1937).
⁴ Wolfe, J. M., *Amer. J. Physiol.*, **115**, 605 (1936).

Dust Control in Industry

IN a recent letter¹ Prof. H. V. A. Briscoe and collaborators report on some work done in connexion with the solubility of quartz and other dusts. Speculating on the practical indications of their results, they suggest that "admixture of a dust such as that of fresh cement . . . might well serve to mitigate the effects of dangerous (that is, silicosis-producing) dusts".

While the suggestion is not sufficiently concrete to afford ground for a fruitful discussion, we are nevertheless curious to learn whether the authors contemplate the possibility of entirely supplanting present unproblematical methods of silicosis prevention by others involving the increase of industrial dust concentrations. We venture the following trivial, but apposite, remarks.

The known positive method of preventing the onset of silicosis among those engaged in dusty trades is to remove the dust from the air they breathe. This can be accomplished either by obliging all persons working in a dusty atmosphere to wear adequate filter masks, air-supplied respirators and the like, or to suppress the dust itself. The former method, although cheaper, possesses many obvious disadvantages, including the difficulty of enforcement, and should be superseded wherever practicable by the latter. Of course, the reduction of dust concentrations to an absolute zero is impossible, for both

engineering and economic reasons. Fortunately, however, in a great majority of cases their reduction to a hygienically satisfactory level is quite feasible. In fact, it is safe to say that if funds and engineering talent were as readily available for dust suppression as a health measure as they are when it becomes a question of protecting an article in process of manufacture from injury by dust, silicosis would soon be of historical interest only.

The procedures are well known: essentially they consist in the control of dust at its sources by means of properly designed and adequately ventilated hoods and enclosures. The expenditures involved are moderately high, but not inordinately so when comparison is made with the annual costs of silicosis compensation, or with the benefits to be achieved. These benefits include, besides the safeguarding of health, many of an intangible but none the less real nature. Almost invariably the brighter and cleaner conditions which follow a serious programme of dust elimination are reflected in increased interest and efficiency on the part of the workers. Fundamentally, dust is an asset in no industry: we have yet to meet the plant manager, however resistant to the invasion of new and expensive ideas, who would assert that it was. Less, not more, dust is desirable from every point of view.

For a number of years public health authorities, insurance companies and similar bodies have been waging an active campaign aiming at the suppression of dust in industry. They have been met half-way by the more progressive sections of industry. The advocacy, in other quarters, of an opposite policy might, however, seriously retard the campaign among the laggards.

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L. B. LEPPARD.
Engineers,

Division of Industrial Hygiene,
Ontario Department of Health,
Toronto.
Sept 2.

HAVING been invited to comment on the foregoing letter, I would first say that I am entirely in sympathy with its main thesis: a plea for the suppression of dangerous dusts by all known means. Unfortunately the authors' enthusiasm for dust suppression leads them to damage a perfectly sound case by overstatement. They seem, indeed, almost to imply that silicosis can be so completely and satisfactorily prevented by masks and ventilation that the investigation of its cause and cure is superfluous.

There are numerous cases, typically in mining and quarrying, where the suppression of dust to anything approaching a safe level is extremely difficult. Moreover, as the authors admit, "the reduction of dust concentrations to absolute zero is impossible", and the whole tendency of our recent work is to show that the finest fraction of active dusts, which is the most difficult to suppress, is by far the most dangerous. It is possible, therefore, that reasonably good ventilation, and still more the wearing of masks, may give a false sense of security.

In these circumstances I am unrepentantly keen to find out why dangerous dusts are dangerous. The fact that some dusts are safe, in the sense that they quite certainly do not cause silicosis even where workers are continuously subjected to relatively high concentrations, is clear proof that the dangerous dusts must differ from them in kind and possess

certain chemical properties wherein their danger lies. Knowing what I know, I would cheerfully work for years in cement dust at a concentration of 10 or 20 mgm. per cubic metre, but I would not willingly work a month in flint or felspar dust of one tenth that concentration.

It seems obvious, therefore, that it is likely to be advantageous to add to a dangerous dust any material, solid, liquid or gaseous, which can be proved to eliminate or even to minimize its dangerous properties. Whether the total concentration of dust is thereby increased is a point of quite minor importance.

Our general findings in the matter of active dusts¹ have speedily been confirmed by the very interesting results recently published by certain Canadian workers², who have not only succeeded, where others have failed, in producing silicosis in small animals by subjecting them to freshly produced (live) dangerous dusts but also have shown that the addition of aluminium powder to these dusts makes them much less liable to produce silicosis.

While I respectfully differ from these workers in holding that much remains to be done before any definite recommendation may properly be made about preventive measures, it is, in my view, now proved that the study of the qualitative properties of dusts will yield valuable results, and we must be prepared, in due time, to follow without prejudice wherever the new knowledge may lead.

H. V. A. BRISCOE.

Imperial College of Science
and Technology,
London, S.W.7.
Oct. 6.

¹ NATURE, 139, 753 (May 1, 1937).

² Briscoe, H. V. A., Matthews, J. W., Holt, P. F., and Sanderson, P. M., *Bull. Inst. Min. and Met.*, April, 1937; June, 1937.

³ Denny, J. J., Robson, W. D., and Irwin, D. A., *Canadian Med. Assoc. J.*, 37, 1 (July, 1937).

Designation of "the Time-Space Continuum"

CUMBROUS language is the enemy of thought. If, as seems likely, the above quadri-verbal septapadialion vocable is to remain a centre of interest and discussion, it needs a handy name.

To this end let authorities bend their fancy and devise a crisp word symbol for the thought. Could this be on the agenda of any learned society? I doubt it. It is the normal job of mathematicians to decree that a simple symbol shall represent a complex; for they know well the advantage of this procedure. Shall the ordinary man be deprived of similar aids?

The new name would no longer need to be wedded to the indicative article 'the'. Just as we say 'time' or 'space' we would say, not 'the time-space continuum' but 'tispacon', or 'espatem', or whatever the name is. My own leaning is for 'spatecon'; but no matter what the word is so it be short.

MERVYN O'GORMAN.

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Pall Mall, S.W.1.
Sept. 18.

Hyperbolic Space

IN NATURE of October 9, 1937, under the heading 'Red shifts and the Distribution of the Nebulae', there is repeated a statement of Dr. Hubble's to the effect that hyperbolic space of negative curvature

leads to a distance-distribution of nebulae which is contrary to observation. It is, however, well known that the distances of nebulae are in no sense 'observed': they are defined by means of theoretical formulae in terms of the observed apparent magnitudes of the nebulae. Moreover, the definitions vary with the process of distance-measurement envisaged. Dr. Hubble's statement is, therefore, only true if (a) we accept his particular definition of distance in terms of apparent photographic magnitude, and if (b) we also accept his identification of this distance with a certain one of the quantities figuring as 'distance' in the model universes of general relativity.

In a detailed investigation, to appear shortly in the *Zeitschrift für Astrophysik*, I have shown that, by retaining (a) and rejecting (b), all Dr. Hubble's observational formulae are in complete accord with a hyperbolic space of infinite extent. His two alternatives, namely, that we must abandon either the homogeneity of the nebular distribution or the expansion of the universe in order to obtain a satisfactory interpretation of the data, do not, therefore, exhaust the possibilities. Both homogeneity and expansion may be retained provided that we modify Dr. Hubble's theory of 'distance'.

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A Cosmic Ray Burst at a Depth equivalent to 800 m. of Water

UNDER the above title we announced in *NATURE*¹ the results of our measurements in a railway tunnel, in which we observed a burst of the size of about 10^7 ions at an equivalent depth of more than 800 m. of water. In the note, however, we regret to have made the following statement, which we should like here to withdraw:

"Both Kolhörster and Corlin² made measurements with an ionization chamber down to 800 m. water-equivalent underground. The cosmic ray intensity at this point was tentatively assumed to be zero. From the above results, however, we see that there still remains a very small part even at this depth."

The fact is that Kolhörster² published, contrary to our statement, the results of his underground measurements by means of the coincidence method, which is independent of any residual ionization.

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C. ISHII.

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Society for the Promotion of Scientific Research,
Institute of Physical and Chemical Research,
Tokyo.
Sept. 24.

¹ Nishina Y. and Ishii C., *NATURE*, **135**, 721 (1936).

² Kolhörster, W., *Sitz. Preuss. Ak. Wiss.*, **699** (1933); *NATURE*, **132**, 407 (1933); *Z. Phys.*, **88**, 536 (1934). Corlin, A., *NATURE*, **133**, 63 (1934); *Ann. Observatory Lund.*, No. 4, A, 95 (1934).

Points from Foregoing Letters

PROF. R. GOLDSCHMIDT describes two cases of spontaneous mutations in *Drosophila*^{*} cultures in which three well-known mutants, and possibly five, were produced by intra-chromosomal rearrangement. The observed mutations, the author states, do not agree with the theory postulating the existence of genes or gene mutations; he would explain mutations as due to changes in the 'correct order' within the chromosome chain, without attaching particular characters to special regions of the chromosome.

A table and graph comparing the ionization produced in various gases by cosmic rays and by gamma rays from radium C, are submitted by J. Juilfs. The ionization is directly proportional to the density of the gases only in the case of the more penetrating cosmic rays, and this fact may serve to distinguish between such cosmic rays and the less penetrating gamma rays.

Two simple camera designs, for X-ray spectrum analysis, are described by W. F. de Jong, who points out a number of advantages resulting from the use of a cylindrical in place of a conical camera.

Using a thin (2 mm.) paraffin layer as 'scatterer' so as to obtain a beam of neutrons distributed more uniformly over the energy spectrum, C. Y. Chao and T. H. Wang have measured the induced radioactivity in silver, rhodium and bromine. Accepting certain approximate values for the cross-sections of their nuclei, the authors calculate the spacing of the resonance neutron levels in the nuclei of those three elements.

Changes in colour produced in a light-coloured dog-fish by injection of pituitary extract are described in detail by D. R. Barry.

Dr. H. H. Pfeiffer discusses the possible nature of the forces acting on chromosomes during mitotic

division, and states that in the case of the nucleus of mesenchyme cells of *Salamander* embryos, cultivated *in vitro*, distinct spindle fibres with positive double refraction arise through the action of a weak mechanical influence on the protoplasm.

Prof. C. Stern suggests a method by means of which it may be decided whether or not end products of genic reactions within the nucleus can exert an influence upon the cytoplasm prior to the breakdown of the nuclear membrane at mitosis.

B. Shapiro and Prof. E. Wertheimer state that, in the rat, excessive liver fat of nutritional origin can be removed by administration of alcoholic extract of pancreas. The treatment does not lessen the body fat, does not increase the acetone body excretion in the urine and does not change the quantity of fat or sugar in the blood. No antagonism between liver fat and liver glycogen was found in these experiments. The effective principle seems to be specific to pancreas.

Further experiments by Dr. B. Mendel and Miss F. Strelitz show that potassium ferri-cyanide, which stops the transformation of glucose into lactic acid (glycolysis) in the presence of air by tumours, does not prevent this process from taking place in kidneys; the inhibitive effect of the ferri-cyanide appears to be specific for tumours.

A number of ethylene derivatives have been tested for oestrogenic activity by Prof. E. C. Dodds, M. E. H. Fitzgerald and W. Lawson. In addition to stilbene and triphenyl ethylene, diphenyl-butadiene has been found to affect the mating instincts of rats from which the ovaries had been removed.

Dr. G. C. McVittie points out that the distribution of spiral nebulae can be interpreted in terms of hyperbolic space provided that some modifications are made in Dr. Hubble's theory of distances.

Research Items

Palaeolithic Succession in England

MR. T. T. PATERSON has inaugurated a study of the palaeolithic succession in England with an examination of finds at Barnham St. Gregory (*Proc. Prehist. Soc.*, 3, 1; 1937). This site, a pit from which brick-earth has been dug, is situated in a small shallow valley running parallel to the Little Ouse near Cambridge. It was discovered in 1933, but implements had been found there previously on several occasions in the brick-earth. The implements now under consideration are found in the gravels and sands, with intercalated beds of clay and silt, in all more than sixty-four feet deep, which underlie the brick-earth. *Coups de poing* were found in the brick-earth, three feet above the gravel surface. In the implements, six industries, five from the gravels, are distinguished by geological horizon, state of wear and patination, and typology. Industry A, the earliest, is heavily rolled and battered and deeply patinated. It is found at depth in the gravels, whereas the others are confined to the top layer. These latter are distinguishable by their depth in the gravel and their patination and wear. Both A and B have suffered from the effects of solifluxion. The sixth industry comes from the brick-earth and is essentially Acheulean, whereas the earlier gravel industries are flake implements. More than 1,500 implements have been taken from the pit, apart from those of tabular flint and rejects. Here then at Barnham is a series of industries showing progressive development along indigenous lines uncontaminated by contact with other cultural techniques. It belongs neither to Clactonian nor proto-Levalloisian; and it is suggested that it be called the Barnham sequence of the Clactonian.

Origin of Tuberculosis and Nature of the Tubercle Bacillus

TUBERCULOSIS in man and animals is almost universally regarded as being caused by infection with a parasitic bacterium, the tubercle bacillus. Prof. J. Tissot, professor of general physiology in the Muséum national d'Histoire Naturelle, Paris, combats this view in an elaborate histological study of tuberculous tissues ("Constitution des Organismes, Animaux et Végétaux: Causes des Maladies qui les Atteignent". Vol. 2, Cause et Nature de la Tuberculose. Paris, at the Muséum, 7 Rue Cuvier: 1936). He maintains that the tubercle bacillus is not a rod-shaped organism (bacterium), but is a dumb-bell-shaped structure derived from embryonic cells in the tuberculous nodules. Tubercle bacilli, according to his view, are the mitochondria of these cells, and so-called cultures of tubercle bacilli are in reality cultures of these mitochondria. Prof. Tissot believes that he has established the fact that tuberculosis develops spontaneously in the individual, and is not usually the result of contagion. He does, however, speak of the 'tuberculous mitochondria' as being a virus, and it is not clear from his monograph in what manner he considers cultures of the so-called tubercle bacillus of the bacteriologist act in inducing tuberculosis, as they certainly do, when inoculated into a susceptible animal.

Embryology of the Ferret

In a previous paper, W. J. Hamilton dealt with the early development of the ferret from fertilization to the formation of the prochordal plate. A recent communication (*Trans. Roy. Soc. Edin.*, 59, (1), No. 5, 1937) carries on the investigation from that point up to the formation of the notochord and the mesoblast. The work is based on a full series of blastoderms from the appearance of the primitive streak up to the formation of seven somites, and in the interpretation the experimental work on Amphibia and Aves has been taken into consideration. The mesoblast differentiates from the ectoderm at the hinder end of the disk and no contributions are made to it by Henson's knot, the notochordal process or the prochordal plate. The anterior end of the differentiation of the primitive streak ceases when Henson's knot appears a short distance in front of it and thereafter it only grows by additions at its hinder end. The downward growth of Henson's knot fuses with the underlying endoderm.

New Species of Mysidacid Crustaceans

PROF. WALTER M. TATTERSALL describes some interesting new mysids ("Reports on the Collections obtained by the first Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep". Johnson Fund. Smithsonian Miscellaneous Collections, 91, No. 26; 1937. Pub. 3413). In addition to the new species, the rare *Lophogaster longirostris*, *L. spinosus* and *Petalophthalmus oculatus* are recorded. A key is given to the species of the genus *Paralophogaster* and a new species *P. atlanticus* added, which differs from *P. glaber*, the type of the genus, in the eyes, antennal scale, rostral plate and telson. All these Atlantic species are closely related, and it is a question whether *P. macrops* described by Colosi from the Red Sea may not be a young form of *P. glaber*. *Gastrosaccus johnsoni* n.sp. is peculiar in its male pleopods, which are very distinctive, especially those of the second and third pairs, and at once distinguish the species from all others of the genus, the females differing only in minor characters.

Asiatic Flower-Birds and American Bird-Flowers

In the warmer regions of Africa, Asia and America, many flowers are pollinated by birds. In America the birds visiting the flowers are mostly humming birds which hover as they drink the nectar; in Asia the birds climb over the branches and extract the nectar when in a hanging or sitting position. W. L. Van der Pijl has therefore spent some time examining the efforts of the sun birds (Nectariniidae) and white-eyes (Zosteropidae) to visit American bird-flowers introduced into Java (*Ann. du Jard. Botanique de Buitenzorg*, 48, Pt. 1; 1937). The original paper must be consulted for details; but, as might be expected, though often visited by the birds, most of these flowers remain sterile; in many cases the calyx or corolla tube has been punctured to enable access to be obtained to the nectar.

Insolation and Relief

THE indirect importance of relief in mountain regions in determining the distribution and intensity of sunshine on different slopes is demonstrated for selected alpine valleys in Switzerland and Austria in a monograph entitled "Insolation and Relief" by Miss A. Garnett (Publication No. 5. The Institute of British Geographers, 1937). From values assessed for sun altitude and direction, valley azimuth and degree of slope, maps and graphs are constructed for the two solstices, the equinoxes and days in early and late summer. The features which they portray are correlated closely with field studies giving details of land utilization, upper limits of crop production, and the distribution of permanent settlements. The results suggest that long duration rather than high intensity of insolation is the factor of most importance geographically, both in determining the upper limits and distribution of cereal cultivation and the position of permanent winter settlements. It is also shown that at some seasons of the year *ubac* (north-facing) slopes that are generally assumed to have low duration of sunshine, in actual fact may have a longer duration than the *adret* (south-facing) slopes, notably in the critical periods of early and late summer. This helps to explain what otherwise seems to be an unusual distribution of habitations and of cultivations in the valleys selected for study.

Crust Displacements in Japan

SERIES of re-levellings recently made in Japan show that, in many districts, chronic crustal deformations are now taking place. In order to study the connexions between such movements and the occurrence of earthquakes, revisions of the levelling have been made in various parts of the country, and especially in 1936 in the southern island of Kyûshû. A comparison between these measurements and those made, for the most part, about forty years ago, has been made by Prof. N. Miyabe, to whom we are indebted for much useful work of the same nature (*Proc. Tokyo Imp. Acad.*, 13, 257-260; 1937). The island is almost bisected by an east-west line between Udo and Nobeoka. In the northern half, the general movement is a tilting of the crust towards the north, the northern end having subsided relatively by about 7 in. To the south of the median line, from Udo to Minemata, the crust has risen as a whole, but, to the south of the latter place, the displacements show marked fluctuations, so that the curve representing them consists of segments of lines. In other words, the movements recorded are those of crust-blocks rather than of the island mass as a whole.

Potential of the Iodine Electrode

THE normal potential of the mercury-mercurous iodide electrode, previously known only by calculation, has been determined by R. G. Bates and W. C. Vosburgh (*J. Amer. Chem. Soc.*, 59, 1188; 1937). The cell consisted of a mercury-mercurous iodide electrode, with electrolytes of potassium iodide and hydrochloric acid, or potassium iodide, acetic acid and sodium acetate, combined with a hydrogen electrode. The E.M.F. values were extrapolated by an equation involving the activity coefficient of hydrochloric acid. In a second series of cells the electrolyte consisted of potassium iodide, sodium acetate and acetic acid, and the extrapolation now involved the molality of unionized acetic acid. The two sets of values were in good agreement, extra-

polation to infinite dilution giving the value $E^{\circ}_{as} = -0.0405$ volt. By combining this with the value of the electromotive force of the cell consisting of lead amalgam, lead iodide, mercurous iodide and mercury, a value for the normal potential of the iodine electrode could be calculated. This was found to be $E^{\circ}_{as} = -0.5356$ volt, in better agreement with the value given by Lewis and Randall, namely, -0.5357 volt, than that in the International Critical Tables, -0.5345 volt.

The β -rays from Lithium and Boron Isotopes

THE radio-elements ${}^6\text{Li}$ and ${}^{10}\text{B}$, obtained by bombarding lithium and boron with fast deuterons, give β -rays with energies up to 12 million volts. D. S. Bayley and H. R. Crane (*Phys. Rev.*, 52, 604) have investigated the upper energy limits of these spectra, and J. J. Turin and H. R. Crane (*ibid.*, 610) have used the elements as a source in a study of the energy loss of energetic electrons in lead and carbon plates. The β -rays were investigated by a cloud-chamber in a magnetic field, the target being bombarded with deuterons immediately before the expansion. Both β -ray spectra have by inspection upper limits at 12.0 ± 0.6 Mev. Since the masses of the atoms involved in the formation and disintegration of ${}^6\text{Li}$, ${}^{10}\text{B}$, are known, the spectra may be used for testing the validity of the theoretical formulæ of Fermi and of Konopinski and Uhlenbeck for the shape of the upper limit. The question is complicated by the fact that protons are produced with unknown energy in the formation of ${}^6\text{Li}$ and ${}^{10}\text{B}$; but accepting indirect evidence for the energy of these particles from the excitation functions, it is found that the Konopinski-Uhlenbeck theory gives considerably too high extrapolated values for the maximum energy of β -emission. The energy loss of β -particles up to 11 Mev. going through carbon is in good agreement with the Bethe-Heitler theory, the loss in lead is more than 50 per cent greater than predicted, but much of this difference is to be accounted for by the scattering of the electrons in the lead, which causes the path in the metal to be considerably greater than that directly measured.

Physical State of Jupiter's Atmosphere

ABOUT three years ago, Dr. H. Jeffreys suggested that Jupiter was composed of a rocky core surrounded by a thick layer of ice, the latter being covered by an atmosphere with a depth of more than 6,000 kilometres. Mr. B. M. Peek (*Mon. Not. Roy. Astro. Soc.*, 97, 8, June 1937) suggests that such an atmosphere cannot exist, his method being an examination of an adiabatic model, an isothermal model, and finally an intermediate model which is a compromise between the first two. For the purpose of numerical evaluation, in the adiabatic and isothermal models the atmosphere is considered to be methane, and in the case of the intermediate type different proportions of hydrogen and methane are taken, and pressure-depths curves are drawn which show the depth at which the solid state is reached. If the atmosphere were composed of pure methane, this depth would be only about 35 km., and if pure hydrogen it would be 270 km. Whatever model be adopted, the depth of the atmosphere is probably limited to about 1 per cent of the radius of the planet. Mr. Peek directs the attention of meteorologists studying Jupiter to the fact that great densities are rapidly attained in the atmosphere, which would almost certainly lose its familiar characteristics below a depth of 25 km.

Science News a Century Ago

Kew Gardens

THE botanic gardens at Kew were founded by Princess Augusta, mother of George III, who began the formation of an exotic garden in 1759 with William Aiton (1731-93) as gardener. The small temples in the grounds were designed by Sir William Chambers in 1760-62. From 1772 until 1819 the gardens were under the care of Sir Joseph Banks. After his death they were neglected, and on October 31, 1837, *The Times* published a communication "From a Correspondent", directing attention to the state of the Gardens. "The great fault in the management at Kew-gardens", said the writer, "appears to be the adherence to a system of niggardly expense and exclusiveness. There does not appear to have been the slightest progress in improvement for many years; the old conservatories and hot-houses seem crammed with plants, in a state of decay or stagnation; everything looks dingy and dirty. . . . There are not sufficient persons in the grounds to attend properly to the cultivation; it is understood that nine or ten men is the whole strength of the establishment, to look after the botanical-garden and also the 'Arboretum', which two divisions it is believed cover nearly six acres of ground. . . . It may as well be mentioned, that a little repair would not hurt one or two of the temples in the pleasure-grounds; and it would also be quite as well if the piece of water, once called the lake, but now an unseemly pond, were emptied of its mud and filth, or quite filled up."

The gardens were rescued from this state of neglect by the work of Sir William Jackson Hooker (1785-1865), who was appointed director in 1841.

The Civil Engineer and Architect's Journal

In October 1837 appeared the first number of the above monthly journal. In the prospectus printed in the first number, it was stated that the journal would contain descriptions and particulars of important buildings, manufactories, warehouses, railways, docks, bridges, piers, harbours, canals, rivers, water-works, gas-works, drainage, mining, steam navigation and machinery, together with notices of the transactions of British and foreign societies, new inventions, patents, books, parliamentary proceedings and "such other useful information connected with the Profession as may make it a work of general reference". The journal was published at 6d. a copy.

The Zoological Society

At a meeting of the Zoological Society held on November 2, 1837, attention was directed to the falling off of the receipts for admission to the gardens, and suggestions were put forward for providing further attractions. Mr. Vigors, M.P., suggested that a suspension bridge should be built to communicate with the grounds of the Society on the opposite side of the Regent's Canal and that bands should be introduced occasionally. In replying to the discussion the chairman, the Rev. John Barlow, F.R.S., said the Council had appointed a committee to report on the deficiency in the garden receipts and that a spirited attempt was being made to introduce two living hippopotami into the collections.

Gresham College

UNDER the above heading, *The Times* of November 3, 1837, said: "Yesterday being the first day of term these lectures commenced in the lecture-room over the east side of the Royal Exchange, when Dr. Southey gave the first of his course on physis. The number of the auditory was 35 persons, or about half the number to which the room could afford accommodation, and which being greater than on previous occasions is to be attributed to the greater additional interest felt by the inhabitants of the city on the subject of this endowment from the steps which have recently been taken to render it more public and useful. The subject chosen by the learned lecturer was the history of medicine."

Dr. Henry Herbert Southey (1783-1865) was the younger brother of Robert Southey, the poet. He was physician to both George IV and Queen Adelaide. He was appointed to the chair of physis in Gresham College in 1834.

Baron Alibert (1768-1837)

JEAN LOUIS ALIBERT, the founder of modern dermatology in France, was born on May 26, 1768, at Villefranche-de-Rouergue in the Aveyron department of France, the son of a magistrate. He studied medicine in Paris, where his principal teachers were Pinel and Bichat, and qualified in 1799 with a remarkable thesis on pernicious fevers, of which several editions were published. His rise in the profession was very rapid, as two years after qualification he was made assistant physician and in the following year full physician to the Hôpital Saint-Louis, which he made the Mecca of dermatologists throughout the world. In addition to several books on diseases of the skin, of which the most important was published in parts between 1806 and 1814, and in which coloured plates appeared for the first time in the history of dermatology, Alibert deserves recognition for his works on therapeutics, of which he was the first professor in the Paris faculty, and a monograph on hydrology. He also won the Montyon prize for a work entitled "Physiology of the Passions", which was translated into German and Spanish. He was the recipient of many honours both at home and abroad. He was physician to Louis XVIII and Charles X, who created him a baron. His death, due to cancer of the stomach, took place on November 4, 1837.

Schönbein and Faraday

In a long letter to Faraday dated November 5, 1837, Schönbein said: "The French papers have been talking for some time about a discovery (said to have been made by a certain Mr. Sorel a Frenchman) which if it should turn out to be something more than a mere news-papers' invention, would be indeed a most wonderful thing. By dint of god knows what sort of substance, the news-papers call it voltaic powder, Mr. Sorel is said to be able of changing Iron and any other readily oxidable metal such as to give them (with regard to their chemical bearings to oxygen) the properties of the precious ones. Such a discovery, of course, cannot be made in our days without being turned to practical advantage and so, indeed, the papers tell us, that Mr. Sorel is going to enter into partnership with the well-known Mr. Cockerill in order to make use of his discovery in the large establishments of the latter gentleman."

University Events

CAMBRIDGE.—R. L. M. Synge, of Trinity College, has been appointed to the Benn W. Levy studentship in biochemistry.

The following grants have been made from the Balfour Fund: £50 to Dr. D. G. MacInnes for research on Tertiary and Quaternary fossil Mammalia of the Rukwa Basin; and £25 to H. W. Lissmann for research at Naples on animal locomotion.

The degree of master of arts has been conferred upon Prof. T. Dalling, professor of animal pathology.

In accordance with its usual practice, Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. Candidates must not have reached the age of twenty-six years before May 1, 1938. Trinity College also offers, as usual, Dominion and Colonial exhibitions to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of £40, but the College Council has power to award an additional payment. A candidate for a studentship or exhibition should apply through the principal authority of his university, and his application should reach the Senior Tutor (from whom further particulars may be obtained) by May 1, 1938.

LEEDS.—The title of emeritus professor has been conferred upon Dr. G. W. Watson, formerly professor of medicine in the University.

LONDON.—Mr. T. C. Stamp has been appointed to the University readership in bacteriology tenable at the British Postgraduate Medical School. Since 1933 he has been lecturer in bacteriology at the London School of Hygiene and Tropical Medicine.

Dr. A. R. Todd has been appointed as from October 1 to the University readership in biochemistry tenable at the Lister Institute of Preventive Medicine. Since 1936 he has been an assistant in the Biochemistry Department of that Institute.

The title of reader in zoology in the University has been conferred on Mr. H. R. Hewer, in respect of the post held by him at the Imperial College of Science and Technology.

The title of emeritus professor of plant physiology in the University has been conferred on Prof. V. H. Blackman, on his retirement from the University professorship in plant physiology at the Imperial College—Royal College of Science.

An offer by Mr. A. Chester Beatty to provide a scholarship in radiology of £400 a year for two years has been accepted with the cordial thanks of the University. This scholarship will enable a student of radiology, after obtaining the academic diploma in medical radiology, to spend a year in one of the great radiological clinics of the United States.

READING.—The honorary degree of D.Sc. will be conferred on the following at a Congregation to be held on November 29, on the occasion of the installation of Sir Samuel Hoare as chancellor of the University: Prof. James Chadwick, Sir Warren Fisher, the Right Hon. the Earl of Iveagh, Sir Thomas H. Middleton and Sir Edward B. Poulton.

Societies and Academies

Paris

September 6 (*C.R.*, 205, 453-472).

ARNAUD DENJOY: The singularities of the analytical function defined by a Weierstrass element.

MARCEL BRELOT: The best or smallest harmonic majorants of sub-harmonic functions.

MME. NATHALIE DEMASSIEUX and BASILE FEDEROFF: The dehydration of the double sulphate of copper and potassium. The changes produced by loss of water on gradual heating have been followed by means of X-ray diffraction diagrams (Debye and Scherrer method). The X-ray photographs for $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and $\text{K}_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ for ten stages of heating are reproduced.

TRYPHON KARANTASSIS and CONSTANTIN VASILIADES: The preparation of the stannosalkyl diiodides and their action on aromatic amines.

ANDRÉ MEYER and HENRI DRUTEL: The condensation of the 2, 6-dimethyl and 2, 8-dimethyl 4, hydroxyquinolines and their derivatives with aromatic aldehydes.

HENRY HUBERT: Storm squalls in western Africa.

ROGER GAUTHERET: Some properties of the apical cells of *Lupinus albus*.

GASTON RAMON: The utilization of anatoxins in the treatment of toxo-infections in the course of development. Sero-anatoxotherapy.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 6, 1937).

L. GODEAUX: Remarks on algebraic varieties of bigenus one.

G. A. BOULENGER: Some advice to naturalists on how to express themselves in their publications, and on the subject of certain errors to be avoided.

M. KOURENSKY: The integration of linear partial differential equations of the first order in two or more unknown functions.

P. BURNIAT: Hypersurfaces and canonical varieties.

MISS D. CRESPIN: The spectral classification of stars of type B and the distribution of absorbent elements in the interior of stellar atmospheres.

M. NICOLET: Note on the hydrogen molecule of stellar atmospheres.

P. LEDOUX: The equilibrium of molecular dissociation in the interior of a stellar atmosphere.

MISS F. DEHALU: New researches on the $\Sigma - \Sigma$ band system of the AlO molecule and astrophysical applications.

B. ROSEN and Miss J. MAT: Isotopic effect in the resonance series of Te_2 .

M. NICOLET: Identification of new lines of NH in the spectrum of the sun's reversing layer.

G. A. HOMES, M. BRUNIN and P. DUWEZ: The state of dislocation of cold-worked metallic crystals.

J. CLAEYS and H. SACK: Some remarks on the absorption of ultra-sound in tubes.

L. MARTON: The electronic micrography of biological objects.

Bull. Classe Sci., 23, No. 7, 1937.

L. GODEAUX: Cyclical involutions belonging to an algebraic variety of genera one.

TH. DE DONDER: The velocity of a coupled reaction.

TH. DE DONDER and J. PELSENEER: The velocity of propagation of light according to Descartes. Contrary to the opinion prevailing at the time of its publication, Descartes' theory did not imply the instantaneous propagation of light.

J. F. COX: Some remarks on a note by Nisoli and Gérard on a new determination of the vertex of the cluster in Taurus and of the star stream in Scorpio-Centaurus.

MRS. J. HENRY-CORNET and L. HENRY: Estimation of bilirubin in blood serum by the spectrographic method.

N. BOUTAKOFF: The flow northwards of Lake Tanganyika during the Pleistocene.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 351-421, July 15, 1937).

C. C. TAN: 'Compressed deficiency' and the location of the spindle attachment in the X-chromosome of *Drosophila pseudo-obscura*.

G. W. BEADLE and B. EHRUSI: Ovary transplants in *Drosophila melanogaster*: meiosis and crossing-over in superfemales. The ovaries of superfemales (individuals containing three X-chromosomes and two antosomes) have been successfully transplanted into normal females. Although such females are low in viability and always sterile, the transplanted ovaries gave fertile eggs. Mortality of eggs and larva was high, however, and this and other results suggest that this particular lack of chromosome balance interferes with crossing-over and hence with the mechanism of meiosis.

A. H. STURTEVANT: An effect of the Y-chromosome on the sex-ratio of inter-racial hybrids of *Drosophila pseudo-obscura*.

A. MARSHAK: Effect of X-rays on chromosomes in mitosis. For both plant and animal tissue, chromosomes are most sensitive to X-rays at the onset of prophase; the frequency of induced abnormalities is independent of wave-length but varies directly as the total length of the chromonemata. The diameter of the 'sensitive volume' of all the chromonemata studied is of the same order of magnitude, and agrees with that of the average diameter of a polypeptide chain or a protamine molecule. Changes in sensitivity to X-rays induced by treatment with ammonia and carbon dioxide also suggest that the 'sensitive volume' consists of material of the type of the protamines or histones.

A. TYLER and N. H. HOBOWITZ: The action of certain substituted phenols on marine eggs in relation to their dissociation. 2,4-Dinitrophenol and various substituted phenols increase the respiratory rate of sea-urochin eggs and at maximum stimulation prevent cleavage; the effect is reversible. The effect on cleavage depends on the concentration of undissociated compound present. Once inside the cells, however, it is the dissociated form that is active.

G. N. SMELL and P. C. AMERSOLD: The production of sterility in male mice by irradiation with neutrons. As with X-rays, the first result of irradiation with neutrons is reduction of litter size, followed by

temporary sterility; but neutrons, as measured by ionization in the bakelite-walled thimble chamber of a standard roentgen meter, are 5-6 times as effective as X-rays.

T. M. SONNEBORN: Sex, sex inheritance and sex determination in *Paramecium aurelia*. In a certain race of this organism, it was found that the individuals could be divided into two classes, sex I and sex II; members of different classes unite for conjugation, while those of the same class do not. Provided neither endomixis (disintegration of meganucleus and its replacement by a fission body of the micronucleus) nor conjugation occurs, all products of fission are of the same sex as their progenitor. At conjugation or endomixis, sex differentiation occurs.

W. J. ROBBINS and MARY A. BARTLEY: Thiazole and the growth of excised tomato roots. While excised tomato roots do not grow in a nutrient solution of mineral salts and pure cane sugar, addition of yeast enables them to grow satisfactorily. For the yeast, one of its constituents, crystalline vitamin B₁, can be substituted. Since vitamin B₁ has been synthesized from pyrimidines and a thiazole derivative, these parent substances were tested, and it was found that the thiazole compound enabled growth to continue. Presumably the thiazole radical of vitamin B₁ is the active substance.

W. J. ROBBINS, MARY A. BARTLEY, A. G. HOGAN and L. R. RICHARDSON: Pyrimidine and thiazole intermediates as substitutes for vitamin B₁. Neither of these classes of compounds can cure experimental polyneuritis in pigeons, but 5 mgm. doses of each, if given not more than 24 hours apart, are effective. It is considered that vitamin B₁ is synthesized from these intermediates *in vivo*.

L. H. GERMER and K. H. STORKS. The structure of Langmuir-Blodgett films of stearic acid. Electron diffraction patterns were obtained from such multiple films deposited on a block of chromium-plated nickel. These patterns indicate that the carbon atoms in these crystals are arranged in zigzag planar chains, the axes of which are nearly, if not accurately, parallel to each other, this direction being inclined downward towards the water surface from the plane of the supporting block. Crystallographic constants have been deduced and the cross-section of the stearic acid reciprocal lattice constructed. The results have been confirmed by the examination by transmission of similar built-up films deposited on a very thin transparent backing foil.

C. STOCK: A peccary skull from the Barstow Miocene, California.

F. D. MILLER: Note on galactic structure: the Milky Way from Aquila to Cygnus.

O. ZARIWAKI: Some results in the arithmetic theory of algebraic functions of several variables.

N. A. HALL: Binary quadratic discriminants with a single class of reduced forms in each genus.

D. LEWIS and M. J. LARSEN: The cancellation, reinforcement and measurement of subjective tones. Experimental results indicate that an audible subjective tone can be increased or decreased in loudness by the introduction of a harmonic of pitch the same as that of the subjective tone. Reinforcement seems to be due to constructive interference, and cancellation to destructive interference; hence the magnitude of the subjective tone can be measured in terms of an equivalent amount of sound pressure. It is suggested that subjective tones have representation in terms of actual vibrations in the cochlea.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 1

INSTITUTION OF ELECTRICAL ENGINEERS (MERSEY AND NORTH WALES (LIVERPOOL) CENTRE), at 7.—Prof. J. Chadwick, F.R.S.: "The Elementary Particles of Matter" (Kelvin Lecture).

Tuesday, November 2

CHADWICK PUBLIC LECTURE (at Manson House, 26 Portland Place, W.1), at 5.30.—Dr. J. M. H. MacLeod: "Leprosy in Great Britain at the Present Time" (Malcolm Morris Memorial Lecture).*

INSTITUTION OF CIVIL ENGINEERS, at 6.—S. B. Donkin: Presidential Address.

Thursday, November 4

INSTITUTE OF FUEL (at the Junior Institution of Engineers, 39 Victoria Street, S.W.1), at 6.—Symposium on "Waste Heat Boilers".

Friday, November 5

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. F. W. Lanchester, F.R.S.: "The Gas Engine and After" (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 7.—Dr. G. S. Baker: "Development of Hull Form of Merchant Vessels" (Andrew Laing Lecture).

INSTITUTION OF GAS ENGINEERS, November 2-3. Ninth Annual Research Meeting to be held at the Institution of Mechanical Engineers.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TEACHER OF ELECTRICAL ENGINEERING in the Norwich Technical College.—The Principal (November 3).

CHEMIST (male) at the Royal Ordnance Factory, Irvine.—The Under-Secretary of State (U.S.), The War Office, London, S.W.1 (November 5).

SCIENTIFIC OFFICER (chemistry), SCIENTIFIC OFFICER (physics), ASSISTANT (grade I, male), and ASSISTANT (grade III, female) in the Research Department, Woolwich, London, S.E.18.—The Chief Superintendent (November 5).

PRINCIPAL of the St. Helen's Education Committee.—The Director of Education, Education Office, St. Helen's (November 6).

LECTURER IN ELECTRICAL ENGINEERING in the Forest of Dean Mining and Technical School.—The Secretary, County Education Office, Shire Hall, Gloucester (November 8).

ASSISTANT LECTURER AND DEMONSTRATOR IN CHEMISTRY in the King's College of Household and Social Science, Campden Hill Road, London, W.8.—The Secretary (November 8).

LECTURER IN PHYSICS in the West Ham Municipal College, Romford Road, London, E.16.—The Principal (November 10).

PROFESSOR OF MECHANICAL ENGINEERING in the Bengal Engineering College.—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (November 12).

ASSISTANTS (grade III) in the Admiralty Chemical Pool.—The Secretary of the Admiralty (C.E. Branch) (November 13).

PROFESSOR OF BOTANY in the University of Melbourne.—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1 (November 30).

ELECTRICAL ENGINEER in the Copper Development Association, Thames House, Millbank, London, S.W.1.—The General Manager.

LIBRARIAN in the University of Liverpool.—The Registrar.

Official Publications Received

Great Britain and Ireland

Sale of Food and Drugs. Extracts from the Annual Report of the Ministry of Health for 1936-37 and Abstract of Reports of Public Analysts for the Year 1936. Pp. 16. (London: H.M. Stationery Office.) 4d. net. [1410]

Development Board (Research Department). Report No. 7: Abstracts on Pig Production made during the Year ending 31.12.1937. Pp. lxi. (London: Bacon Development Board.) [1510]

British Museum and British Museum (Natural History). Annual Report of the General Progress of the Museum for the Year 1936; with a Return of the Number of Persons admitted to the Museum and a Statement of the Principal Objects added to the Collection. Pp. 24. (London: H.M. Stationery Office.) 4d. net. [1510]

Universities Bureau of the British Empire. Report of the Executive Council together with the Accounts of the Bureau for the Year 1st August 1936 to 31st July 1937. Pp. 24. (London: Universities Bureau of the British Empire.) [1510]

Other Countries

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 15. Pp. iii+193. (Paris: Les Presses universitaires de France.) [1210]

Ministère de l'Éducation nationale: Université de Paris, Faculté des Sciences: Institut de Physique du Globe. L'Observatoire géophysique de Chaumont-la-Forêt. Pp. 20. (Paris: Imprimerie Gauthier-Villars.) [1210]

Indian Lac Research Institute. Bulletin No. 27: A Technical Process for Washing and Refining Stick Lac. By A. K. Thakur. Pp. 13+2 plates. (Nankun: Indian Lac Research Institute.) 3 annas. [1310]

Bulletin of the American Museum of Natural History. Vol. 73, Art. 8: Skull Structure of the Multituberculata. By George Gaylord Simpson. Pp. 727-783. (New York: American Museum of Natural History.) [1310]

Bulletin of the Bingham Oceanographic Collection. Vol. 6, Art. 3: Report on Hydrographic Observations at a Series of Anchor Stations across the Straits of Florida. By Albert Elde Parr. Pp. 62. (New Haven, Conn.: Yale University.) [1310]

Royal Agricultural Society, Cairo. Technical Bulletin No. 31: Experiments in Egypt on the Interaction of Factors in Crop Growth. 7: The Influence of Manuring on the Development of the Cotton Crop. By Dr. Frank Crowther. Pp. 70. Technical Bulletin No. 32: Experiments in Egypt on the Interaction of Factors in Crop Growth. 8: Manuring of Cotton in Egypt. By Dr. Frank Crowther, Adolf Tomford and Ahmed Mahmoud. Pp. 38. (Cairo: Royal Agricultural Society.) [1310]

Bulletin of the National Research Council. No. 100: An Experimental Study of the Problem of Mitogenetic Radiation. By Alexander Hollander and Walter D. Claus. Pp. 96+4 plates. (Washington, D.C.: National Research Council.) 1 dollar. [1410]

U.S. Department of Agriculture. Circular No. 439: Parasitization of the Mediterranean Fruitfly in Hawaii, 1914-33. By H. F. Willard and A. C. Mason. Pp. 18. 5 cents. Picture Sheet No. 1: Tomato-Hookworms. Pp. 2. 5 cents. Picture Sheet No. 2: Mexican Bean Beetle. Pp. 2. 5 cents. Picture Sheet No. 3: Colorado Potato Beetle. Pp. 2. 5 cents. (Washington, D.C.: Government Printing Office.) [1410]

Brooklyn Botanic Garden Record. Vol. 26, No. 3: Botanic Gardens of the World; Materials for a History. Pp. 149-354. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) 2 dollars. [1510]

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 79: Les fossiles du Jurassique de la Belgique avec description stratigraphique de chaque étage. Par Prof. Henry Joly. Pp. 248+3 plates. Deuxième partie: Lias inférieur. Mémoire No. 80: The Crocodile of Maransart (*Dollosuchus dixoni* Owen). By W. E. Swinton. Pp. 46+1 plate. Deuxième Série, Fasc. 8: Limnides jurassiques de l'est du bassin de Paris. Par Dr. Colette Dechaseaux. Pp. 58+3 plates. Deuxième Série, Fasc. 10: The Anatomy of some Protobranch Mollusks. By Prof. Harold Heath. Pp. 23+10 plates. Deuxième Série, Fasc. 11: Revision des Onitides. Par André Janssens. Pp. 200+2 plates. Hors Série: Résultats scientifiques du voyage aux Indes orientales Néerlandaises de L.L. A.A. R.R. le Prince et la Princesse Léopold de Belgique. Vol. 5: Vertébrés. Fascicule 4: Oiseaux, par Ch. Dupond; Säugetiere, von E. Schwarz. Pp. 72+3 plates. (Bruxelles: Musée Royal d'Histoire Naturelle de Belgique.) [1510]

U.S. Department of Agriculture. Farmers' Bulletin No. 1790: How to Fight the Chinck Bug. By C. M. Packard and Curtis Benton. Pp. 11+22. (Washington, D.C.: Government Printing Office.) 5 cents. [1510]

National Research Council of Canada. Moisture on Windows. By R. Ruedy. Pp. 8. (Ottawa: National Research Council.) [1510]

State of Illinois: Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 21, Article 3: Studies of Nearctic Aquatic Insects. 1: Nearctic Alder Flies of the Genus *Sialis* (Megaloptera, Sialidae), by H. H. Ross; 2: Descriptions of Plectoptera, by T. H. Frison. Pp. 53-99. (Urbana, Ill.: Illinois State Natural History Survey.) [1510]

Meddelanden från Statens Skögsförsöksanstalt. Häfte 30, 1937. Pp. iv+716. (Experimentalfältet: Statens Skögsförsöksanstalt.) 12.00 kr. [1510]

Astrophysical Catalogue 1900-0. Sydney Section, Dec. -61° to -65°, from Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 15: R.A. 12h to 16h, Dec. -54° to -56°, Plate centres Dec. -55°. Pp. 64. Vol. 16: R.A. 16h to 24h, Dec. -54° to -56°, Plate centres Dec. -55°. Pp. 32. (Sydney: Government Printer.) [1510]

Catalogues, etc.

Apparatus for the Testing and Analysis of Oil, Tar and their Products. (Catalogue No. 15B, Section K.) Pp. iv+108. (London: Griffin and Tatlock, Ltd.)

Mandelal (Compound Calcium Mandelate B.D.H.) in the Treatment of Urinary Infections. Pp. 8. (London: British Drug Houses, Ltd.)

Instruments for the Measurement of High Vacua. (Mss. 1.) Pp. 8. (London: W. Edwards and Co.)

Numismatik: Bücher, Abhandlungen, Zeitschriften. (Antiquarische katalog Nr. 714.) Pp. 136. (Leipzig: Gustav Fock, G.m.b.H.)

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3549

SATURDAY, NOVEMBER 6, 1937

Vol. 140

Higher Education for African Natives

ONE of Mr. Ormsby-Gore's first acts on his return to the Colonial Office was the appointment of a representative Commission, under the chairmanship of Earl De La Warr, to make a comprehensive survey of the educational facilities provided in East Africa, to report on the development of its higher educational institutions, and to make detailed proposals for the establishment of a college of university standing for East Africans. The Commission spent from January 11 until February 19 in East Africa, and a few weeks ago presented its report.*

The outstanding features of the report are its freedom from cant, its warm sympathy with, and appreciation of, the potentialities of the Africans, its realization of the composite conditions which have been created by the impact of the European theory of progress on the African theory of traditionalism, and its desire to provide education services to enable Africans to cultivate their undeveloped powers, not for their good alone, but also for the benefit of the world. Throughout its labours the Commission had prominently before it the application of the two principles of trusteeship: the development of the peoples, and the development of the natural resources of the territories they inhabit. It rightly concludes that the better education of the African is essential to both kinds of development. As axiomatic to its report it states the two propositions that the primary need of East Africa is the improvement of health and agriculture, and that such improvement can best be achieved through the general education of Africans and by training sufficient numbers of qualified African experts.

* Higher Education in East Africa. Report of the Commission appointed by the Secretary of State for the Colonies. (Colonial No. 142). Pp. 136. (London: H.M. Stationery Office, 1937). 2s. 6d. net.

There have been several commissions on East African development. All have expressed the conviction that only from the Africans themselves can enough qualified men and women for the medical, agricultural, veterinary, forestry, railway, public works and education services be obtained at an economic cost. To this Commission belongs the distinction of being the first to give details of the requirements of these essential services for qualified African personnel. It states that within the next ten years, Uganda, Kenya, Tanganyika and Zanzibar will require at least nine hundred college-trained African men and women for these services and about the same number of Africans who have had a full course of secondary school training. Taking into consideration other avenues of employment for those who have received a secondary school training, and assuming that the average college graduate will look for a wife who has at least had that advantage, the Commission estimates that useful occupations can be found for more than four thousand secondary school pupils.

The absorption of an average of four hundred educated Africans a year for the next ten years in the service of nearly twelve million of their fellows does not appear too ambitious a project at first sight. There are, however, obstacles which cannot be surmounted without a thorough overhaul of the education services. A great and courageous effort has to be made to broaden the base of the pyramid on which the education of the African is built. The local governments must assume a much greater responsibility for the finance and guidance of education agencies, and cease to regard expenditure on education as one of those luxuries

on which to practise self-denial in times of economic depression. The task cannot and should not be left so largely to the Christian missions. The local governments must supplement missionary pioneer effort by the provision of model institutions while encouraging the missions to improve those under their care. After sixty years of education in Uganda—and Uganda is the brightest spot in East African education—there are still not more than forty schools fit to provide a full primary course of six years. The fact that upon this small basis it was possible to recruit pupils to Makerere College in Uganda for a training to enable them to take places in the government services is evidence of the keenness of the African for education, rather than a matter for complacency. Makerere and its allied institutions are still unable to deal with the requirements of the Uganda Government alone for trained unqualified assistants for the public services, and it is neither equipped nor staffed to provide the territories with university-trained, professionally qualified staffs. It is clear, therefore, that “a large expansion and improvement will be required in all stages of education, primary, secondary, and post-secondary” throughout the East African territories. The instruction in all types of schools, in spite of the advice and assistance persistently given by the Colonial Office Advisory Committee on Education, is mostly of the kind that was discarded as unsuitable in European schools years ago. It is certainly not calculated to give an African an intelligent appreciation of his own surroundings.

It was suggested in the evidence given to the Commission that the paramount need of the territories was for African assistants to work under European officers, and that plans for the establishment of university courses were therefore premature. The reality the Commission faces, however, is the demand by Africans for university training and full professional status, and that unless they find means to attain it in Africa they will seek it overseas. The governments need Africans of the highest qualifications to undertake an ever-increasing share of the responsibility in every department. To restrict Africans permanently to a low standard of employment is impossible. It would foster discontent. It would be a denial of the policy of trusteeship which, as the Commission says in a trenchant passage,

“has been proclaimed as the policy of His Majesty's Governments. It is a policy which will have to confront inconvenient problems, and which already

inspires young energies and fresh ambitions. Yet if the concept of trusteeship, if the method of Indirect Rule, are to be anything more than glib evasions of responsibility they must assert that the African shall in due course reach full maturity and take his place among the peoples of the world”.

The Commission therefore recommends that the East African Governments should announce forthwith “a policy offering facilities for training Africans in due course to full university standard, and of giving them opportunities thereafter to rise in the service to the highest responsibilities commensurate with their abilities”. This policy obviously implies the provision of primary and secondary education on a most liberal scale in all the East African territories, to act as feeder institutions to the higher college.

The Commission definitely recommends the establishment of a university college in the near future and of a university at no very distant date. It is aware of the “present very flimsy foundations of primary and secondary education upon which such institutions will need to be based, and realizes the possible risks of too rapid advance and of a top-heavy structure”. Nevertheless, it is convinced that the risk should be taken, believing that Africa can profit by our long and painful experiments, and can advance at a pace far greater than was possible for Europe a hundred years ago.

The Commission proposes that the constitution of the higher college should be similar to that of institutions of university rank in the United Kingdom; in other words, that it should be under the control of an autonomous independent body, with trustees, appointed by the Secretary of State for the Colonies, to administer an endowment fund of at least £500,000, which it is hoped will be forthcoming from the local governments, the Imperial Exchequer, and private donors. The initial capital outlay required for buildings and equipment is estimated at less than £200,000. Of the total sum required Uganda is expected to contribute £300,000 from its surplus balances, which leaves less than £400,000 to be provided from other sources. This appears a small price to pay for the provision of an institution which should, if it is properly staffed and equipped and directed by an inspiring personality, become a centre of learning and research from which East Africa should be able to draw on the intellectual resources of the world through the medium of its own people.

A. G. C.

Mineral Chemistry and Crystal Structure

Atomic Structure of Minerals

By Prof. W. L. Bragg. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University). Pp. xiii + 292. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1937.) 18s. net.

THOUGH only twenty-five years have elapsed since in June 1912 the interference phenomena of X-rays on crystals were discovered by M. von Laue and his collaborators, experimentally determined atomic arrangements are to-day available in sufficient number to form the subject-matter of a notable book. This advance has to a large extent been the result of work carried out in the laboratories of Sir William Bragg and of Prof. W. L. Bragg, and mineralogists will be grateful to the latter for having given them a first-hand and illuminating account of the results achieved. Prof. Bragg's book shows clearly, as do in a more detailed fashion the "Strukturberichte" published by the *Zeitschrift für Kristallographie*, the amazing extent to which crystallography has been developed by the united researches of physicists, chemists and mineralogists. A single new method of experimental investigation has served not merely to solve—or at least to define more clearly—a multitude of old problems, but also by opening up entirely new vistas has enabled many questions not thought of hitherto to be precisely formulated.

After giving a short but instructive introduction on the fundamental principles of space lattice crystallography and on crystal analysis by X-rays, Prof. Bragg proceeds to what is the main subject of his book, the description of actual mineral structures. Aided by a large number of excellently drawn figures, he discusses in turn the elements, halides, sulphides, arsenides and related compounds, oxides, oxygen salts and silicates, thus adhering to the traditional sequence followed in mineralogical text-books. It is obvious that the description of the silicate group, comprising as it does by far the most important minerals, must occupy most space. Actually, about half the book is devoted to their structures, and the introduction to this chapter shows clearly that X-ray data have furnished quite new principles for the classification of the minerals concerned. The author makes it clear that the various types of silicon-oxygen framework in the silicates are due to a linking of the tetrahedral silicon-oxygen groups which resembles polymerization, and accordingly subdivides the silicates into the following classes: silicates containing separate SiO_4 groups, aluminosilicates, structures containing

complex silicon-oxygen groups, pyroxene and amphibol groups with silicon-oxygen chains, mica and clay groups with sheets of linked silicon-oxygen tetrahedra, a felspar group with a silicon-aluminium-oxygen framework, zeolite, and other framework structures with acid radicals or molecules of water or other compounds in the cavities. This enumeration alone suffices to show how great the changes are which have been introduced into our conceptions of silicate chemistry by the use of X-rays, and it is a remarkable fact that idealized atomic arrangements can already be given for nearly all the important rock-forming minerals such as the plagioclases, alkali-felspars, feldspatoids, micas, amphibols, pyroxenes, zeolites, and of olivine, garnet, chlorite, talc, kaolin, vesuvianite, melilite, titanite, cyanite, sillimanite, andalusite, staurolite, etc.

In some of these silicates, hydroxyl groups are present as well as the aluminosilicate anions, and an important part is played not only by the silicon-aluminium-oxygen arrangement, but also by octahedral units with Al, Mg, Fe, Ti, etc. as co-ordination centres and O, OH or F grouped around them. A somewhat more detailed consideration of these circumstances might, perhaps, have been the starting-point for a stricter systematic arrangement of silicate structures. It is clear, however, that Prof. Bragg's book can offer only the foundation for a mineral chemistry based on crystal structure. Of many problems, such as the limits of isomorphic replacement in relation to structural types, the variation in composition of many minerals, the limits of stability of various structures, their possible deformations, etc., which to the mineralogist appear of fundamental importance, he can give but brief indications. The many new problems which present themselves in these connexions can only be solved by the united efforts of analytical-chemical, paragenetic and structural investigations. The relations which exist between structure on one hand and morphology, cleavage, twinning, etc., on the other, have not been neglected by Prof. Bragg, though it was not, of course, his intention to enter very deeply into these subjects. It may be said, however, that such excursions as he does make into these side-issues are admirably adapted to remind the mineralogist that a thorough knowledge of atomic arrangements is a fundamental necessity for the solution of his major problems.

Taken as a whole, the book provides a typical example of modern trends of development in the field of natural science. The barriers which formerly existed between the various branches

have fallen, and subjects such as the nature of matter, the structure and grouping of atoms, etc., have come to be of equal interest to astronomy, physics, chemistry, mineralogy and biology. Each of these has its own part to contribute towards the

solution of common problems. Mineralogists are greatly indebted to the physicist whose book does so much to place mineral chemistry on a new foundation.

P. NIGGLI.

Lomonosov and Early Science in Russia

Trudy M. V. Lomonosova po Fisike i Chimii By B. N. Menshutkin. Pp. 537 + 5 plates. (Moscow and Leningrad: Izdatelstvo Akademii Nauk SSSR, 1936.) 13 rub. (In Russian.)

M. V. LOMONOSOV (1711-1765), the first Russian man of science, has often been described by his fellow-countrymen as a 'Samorodok', a word meaning 'nugget'. This translation, however, does not convey quite the meaning which Russians attach to 'Samorodok'. It actually conveys something "of a spontaneous nature coming to life without an external incitement".

To realize what an exceptional man Lomonosov was, one has only to refer to the history of the Russia of two centuries ago. Peter the Great was putting the finishing touches to gigantic reforms and "hacking the window" in the wall surrounding dark Russia. One of the new institutions established by the Tsar was the Academy of Sciences, in which Lomonosov was to lay the foundation stone of Russian experimental science.

Prof. Menshutkin's book on Lomonosov's achievements in physics and chemistry has been the work, with some unavoidable interruptions, of some thirty years. It presents a summary of many manuscripts found in the rich archives of the Academy of Sciences of the U.S.S.R. and of many other documents relating to this Russian man of science, discovered among the papers in various State institutions. As many of the "Discourses" and "Dissertations" of Lomonosov were originally written in Latin, Prof. Menshutkin has translated them into Russian, giving very interesting explanations and, whenever necessary, commentaries, adding to this most valuable material numerous notes on contemporary men of science with whom Lomonosov came in contact in Russia and abroad.

In his preface to the book, Prof. Menshutkin remarks that one cannot realize the full significance of Lomonosov in the history of the Russian science unless one knows something about the life of the great man.

Lomonosov was born in 1711 of peasant parents in a village, some hundred miles away from the White Sea. Already in 1723 we find his signature appended to certain village documents which he signed on behalf of his illiterate relatives. At that

time, we learn, he read psalms in the church and knew by heart a score of books available in the village. At the age of nineteen years, in 1730, he went to Moscow to study at the Academy, a school conducted by the monks of a monastery. There he distinguished himself, and in 1736 was sent with other young students to the Academy of Sciences founded by Peter the Great (1725) in St. Petersburg. It happened that the Academy was requiring "an experienced chemist with knowledge of mining" to be sent to Kamchatka. As no such man was available in Russia, it was decided to send three Russians to Germany to acquire the necessary knowledge. Among these three was young Lomonosov.

His first place of study was Marburg, where he worked under Prof. Chr. Wolfe. Lomonosov spent five years abroad, and upon his return to St. Petersburg submitted to the Academy several dissertations, among which was one on an optical instrument invented by him, as well as several other works: "On Silver and Mercury", "Elements of Mathematical Chemistry". One of the theses of the latter was "Chemistry—the Science of Substitutions taking Place in a Compound Substance". This paper, says Prof. Menshutkin, shows Lomonosov's great ability in handling a complex theory and demonstrates the vast amount of general knowledge and facts acquired by him in the University of Marburg under the guidance of Wolfe.

The learned administration of the Academy was very favourably impressed by Lomonosov's dissertations, and he was soon appointed junior professor at the Academy. His next contribution was a translation of Wolfe's experimental physics, a work done, according to Prof. Menshutkin, in a most brilliant way. No Russian scientific vocabulary existed at that time, and Lomonosov had to create new words and expressions, many of which are still being used in Russia.

In response to Lomonosov's request, funds were granted for erecting a laboratory, where he pursued researches on most varied subjects. One of them was a theory of atmospheric electricity. A machine, "Thunder Machine", was built and experimented with, and one day his colleague, the academician Prof. Richman, was killed by an electrical discharge from it. However, a few months later

Lomonosov read at a meeting of the Academy, to commemorate the untimely death of Richman, a paper on "Aerial Phenomena due to Electricity".

Lomonosov was strongly under the influence of the then widely discussed corpuscular theory of matter. On his return to Russia, he devoted himself seriously to the development of this theory. All his dissertations and discourses bear witness to that, and throughout all his works we find the same familiar theme. While propounding the corpuscular theory, Lomonosov, however, submitted it to an original and constructive criticism. The *Proceedings of the Academy of Sciences* of 1744 contain an elaborately prepared dissertation "On Inanimate Physical Corpuscles forming Part of Bodies, in which Sufficient of the Peculiar Rudiments of the Whole Body is Enclosed".

Heat as a complex molecular motion was the next theory Lomonosov brought to the notice of his learned colleagues. It had an indifferent reception, and he was criticized for his irreverent treatment of Boyle. The study of the elasticity of the air, of its composition, hydrodynamics, etc., followed as a logical sequence to Lomonosov's work on the corpuscular theory. A dissertation "On the Origin of Light and a New Theory of Colours" was presented to the Academy in 1756. His work "On the Ratio between the Quantity of Matter and Weight" was discussed at the Academy the same year. After these followed:

"On Solid and Liquid Bodies", "On the Action of Chemical Solvents", "The Nitre", etc.

The profoundly scientific treatment of any subject under discussion, Prof. Menshutkin says, is the main characteristic of all Lomonosov's works; for Lomonosov, chemistry was a pure science and not an art. "It is curious to note", remarks Lomonosov himself in his preface to the translation of Wolfe's "Physics", "how little attention learned men pay nowadays to the ideas born in their own heads, and strive more and more to make deductions from the results of experiments".

Lomonosov was a great experimenter and brilliant theorist. His work on physical chemistry, envisaged in the light of the history of science and of the contemporary achievements in this domain loses none of its interest and originality. A comparison of Lomonosov with Mendeléeff at once suggests itself, says Prof. Menshutkin. They both show a remarkable similarity of their genius. Both were physical chemists, whose interest centred chiefly in a particular class of research—that of solvents. Both adopted a serene philosophical attitude in their teaching, and yet both remained practical workers; throughout their lives Lomonosov and Mendeléeff remained great Russian patriots endeavouring to bring scientific conquests within the reach of their Fatherland. "Lomonosov was the Mendeléeff of the eighteenth century, and they were both Titans of Science". S. S. IVANOFF.

Scientific Study of Folk-Lore

Volkstumsatlas von Niedersachsen
Von Wilhelm Pessler. (Veröffentlichungen der Historischen Kommission für Hannover, Braunschweig, Schaumburg-Lippe und Bremen, 14). Lief. 1. Pp. 20 + 8 maps. Lief. 2. Pp. 12 + 5 maps. (Braunschweig: Georg Westermann, 1933, 1936).

FOLK-history is beginning to supplement the accounts of Church and State which have hitherto been our guide to the past. The thoughts, customs and actions of a people are, indeed, the most reliable index to their state of culture, and a true understanding of any race can scarcely be obtained without a knowledge of its folk-lore. Dr. Wilhelm Pessler is writing the folk-history of Lower Saxony, the province of Germany between the lower parts of the Rivers Ems and Elbe, with Hanover as its principal city, and the publications under notice represent a contribution to the personal and agricultural customs of the province. A series of large, detailed maps shows the distribution of methods of yoking draught oxen, the

stooking of rye, the use of children's cradles, and even of less tangible affairs, such as the charming (*Besprechen*) of ailments, the most suitable days for marriage, and belief in luck. An explanatory text accompanies each map, and provides illuminating information. Charming of ailments, for example, thereby appears as a practical psychology of medicine rather than a survival of archaic custom. The information has been gathered together as the result of a large number of questionnaires sent to about 1,800 people in all parts of the province, and is part of a more comprehensive scheme fostered by the Notgemeinschaft der deutschen Wissenschaft. The "Volkstumsatlas von Niedersachsen" is published under the aegis of the Historische Kommission zu Hannover.

Results portrayed on the maps sometimes show well-marked divisions of ideas and interests in various parts of the province. Methods of stooking rye, for example, exhibit sharp variation by districts. There is, however, strong support to be gained for the view that man is not largely

dominated by his environment. Given a set of ideas which satisfy his reason, he will hold them and put them into practice, without undue reference to geographical surroundings. This is seen more on the maps relating to folk customs than on those which refer to agricultural practice, though the latter sometimes exhibit the same phenomenon.

Dr. Pessler is to be congratulated upon the artistry of his maps, the scholarly nature of the text, and the completeness of his investigation. The human appeal of such studies in folk-lore finds a strong expression in the Niedersächsisches Volkstummuseum at Hanover, of which Dr. Pessler is director. A number of exhibits, particularly of houses, are presented there with a

reality which commends itself to remembrance. Some re-erected houses and rooms are quite open to the visitor, who can thus make a quiet excursion into a different historical environment, whilst an extensive series of models interprets the development of farm-houses in Lower Saxony. Dr. Pessler has also written many papers upon this aspect of folk-lore. Mention may be made of "Harzer Häuser" (*Monatsschrift für Kultur- und Heimatpflege Niedersachsen*, Jan. 1937), which is a study of house architecture and types of dwellings in the Harz mountains, and "Das Niedersächsische Bauernhaus", a study of the development of farm-houses in Lower Saxony (from the Niedersächsisches Volkstummuseum, Hannover, 1936).

J. G.

A Census of Periodicals

Union Catalogue of the Periodical Publications in the University Libraries of the British Isles, with their respective Holdings, excluding Titles in the World List of Scientific Periodicals, 1934. Compiled on behalf of the Joint Standing Committee on Library Co-operation by Marion G. Roupell. Pp. xii + 712. (London: National Central Library, 1937.) 52s. 6d.

THIS publication provides for the first time a list of periodicals both humanistic and scientific, English and foreign, whether still appearing or not, so far as they were possessed by the library of any university or university institution in the British Isles at the end of December 1935, but excluding those published in the years 1900-33, and referred to in the "World List of Scientific Periodicals".

The term 'university institution' has been interpreted broadly, since the libraries of the Lister Institute, the Rothamsted Experimental Station and the Pharmaceutical Society are among those included.

23,115 different periodicals are listed with full particulars of the original title and all subsequent changes, volume numbers, dates and places of publication. In addition, the same alphabetical sequence includes some 32,000 cross-references from all changes of title, and from the various bodies responsible for publication. With the help of these informative cross-references, research workers faced with an unknown abbreviation, or knowing only the name of the publishing body, will rapidly find the necessary clue.

To test the accuracy of the work, a number of publications were looked for which were known to be obscure and difficult to trace, and in every instance the quarry was tracked with extreme ease.

Whilst the work will be of particular value to workers in fields other than scientific, it will also be of considerable use to scientific investigators, containing as it does those periodicals which lived and died prior to 1900, or came into being after 1933, and thus do not come within the scope of the "World List".

Of a necessity the editors have had to exclude certain weekly periodicals, if only to prevent the work becoming unwieldy, but the method of discrimination is not very obvious in cases such as the *Athenæum*, which is omitted, whilst the *Academy* is retained. This, however, is a minor detail, and does not detract from the extreme usefulness of the work.

The preface contains an expression of belief that the volume will be of service to libraries in revising their own buying of periodicals, etc., but it is much to be hoped that should any process of 'weeding' be indulged in, those responsible will consult the Joint Standing Committee before taking definite action. Otherwise two libraries may each dispose of a rare set on the grounds that it is possessed by the other, as has already occurred since the publication of the "World List".

The Catalogue has been compiled under the direction of a distinguished editorial board, whilst the trustees of the Carnegie United Kingdom Trust have generously rendered financial assistance both in compilation and in publication. All concerned are to be heartily congratulated upon having produced a great census and directory of the wealth of periodicals contained in the university libraries of the British Isles, which at the same time constitutes a bibliographical list of permanent value.

F. W. OLLIFFORD.

Rapports sur la photoluminescence présentés à la réunion Internationale de Photoluminescence, Varsovie, 20-25 Mai 1936

Publiés par la Société Polonaise de Physique sous la rédaction de Prof. Dr. S. Pieńkowski et Dr. W. Kapuściński. (Vol. 5 des *Acta Physica Polonica*.) Pp. ix + 431. (Wilno: *Acta Physica Polonica*, 1936.)

THE first International Conference on Photoluminescence, which was held at Warsaw in May last year, was presided over by Prof. P. Pringsheim and attended by many eminent European physicists. It served to bring to the forefront the important scientific results which the subject is at present yielding. Some twenty-seven papers on the various aspects of phosphorescence and fluorescence were presented. They have now been published by the Polish Physical Society in the volume under notice.

It is only possible to mention here a few of the interesting topics which came up for discussion. Among the papers dealing with the line fluorescence of atoms, that by W. Hanle is of considerable importance as it deals with the influence of electric and magnetic fields on the polarization of resonance fluorescence. This constitutes one of the main methods of measuring the lifetime of an excited atomic state. The continuous absorption and fluorescence of van der Waals' molecules (as formed, for example, from an excited mercury atom with a rare gas atom) is treated by W. Finkelburg. The interesting paper by V. Kondratjew on the luminescent emission of flames discusses very clearly the difference between thermoluminescence and chemiluminescence as revealed in their respective behaviour towards quenching by foreign molecules. A number of papers are devoted to fluorescent, phosphorescent and pre-dissociation phenomena in the gaseous state. Another section deals with these phenomena in solution and in the adsorbed state. Finally coming to solids, R. Tomaschek discusses the line emission of the rare earth phosphors and R. W. Pohl the absorption spectra of the alkali halide crystals.

While most of the papers are in the nature of reports summarizing the work of the different authors in their respective fields, they also contain original material, and the discussions following each paper contain valuable contributions to the subject.

W. C. PRICE.

The Biochemistry of the Lipids

By Dr. Henry B. Bull. Pp. ix + 160. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 13s. 6d. net.

WHEN an author apologizes so profusely as does Dr. Bull for writing a book on a particular subject, the reviewer is to a great extent disarmed. There are, however, several comments which may be made for the purpose of general information.

As usual in a text-book on a specialized part of biochemistry, terminology is discussed, since the leading workers in this field are still not agreed among themselves. British workers have generally adopted the classification proposed by Dr. Smedley-Maclean, who has herself made so many notable contributions in this field. "Lipides" may be confused with "lipins",

and both these words together with "lipoids" generally signify substances of a fat-like nature yielding on hydrolysis fatty acids or derivatives of fatty acids, and containing in their molecule either nitrogen or nitrogen and phosphorus. This is the well-known and generally accepted definition given by Maclean and Maclean. Some confusion may therefore arise since "lipids" as used by the author signifies not only the above substances but also the simple fats and waxes and even the sterols.

The author has therefore aimed at comprehensiveness rather than completeness and has supplemented his description of individual substances by a detailed bibliography. The treatment of the fatty acids and the soaps is especially good and up to date, but the treatment of other classes of the "lipids" suffers considerably by the severe condensation.

An unusual formula is given, without comment, for sphingosine and consequently for sphingomyelin, but, apart from this, the book forms a good if rather hurried introduction to an important class of biochemical substances on which much investigation is being made.

C. S. G.

Les plantes alimentaires chez tous les peuples et à travers les âges:

histoire, utilisation, culture. Vol. 4: Les plantes à boissons. Par Prof. D. Bois. (*Encyclopédie biologique*, Vol. 17.) Pp. iv + 601. (Paris: Paul Lechevalier, 1937.) 120 francs.

THIS volume of the "Encyclopédie Biologique" deals entirely with those plants that are used by man in various parts of the world for preparing beverages. All the more important species are dealt with, but those regarded as purely medicinal are omitted. They are arranged in three main categories—plants yielding alcoholic beverages such as wine, beer, cider, perry and distilled spirits; non-alcoholic drinks such as fruit syrups obtained by expression, and aromatic, non-alcoholic beverages, made by infusion or decoction, such as tea, coffee and cocoa. As might be expected in a work of this sort emanating from France, the grape and its numerous beverages receive detailed attention. Brief descriptions of all the leading varieties of wine grape, including synonyms, are given. Among the beverages of the tropics are the various palm wines or toddy and the spirits they yield (arack), also the spirits and native beers prepared from millets and other cereals. Maté or Paraguay tea and guarana, so well known in South America, are fully discussed. No fewer than eighty substitutes for ordinary tea are given and twenty for coffee.

A good deal of useful historical information and facts not usually recorded appear within the pages of the book. It is interesting to read, for example, that the flowers of the Indian 'mahua' tree, *Madhuca latifolia* (syn. *Bassia latifolia*), used in India for sweetening and making fermented liquors, were imported into France in 1880 to the extent of 400,000 kilogrammes for the manufacture of alcohol. Their importation and use in this manner, however, was afterwards banned by the French Government.

Indiana

By Prof. Dr. Leonhard Schultze Jena. 1: *Leben, Glaube und Sprache der Quiché von Guatemala*. Pp. xii+394+24 plates. 34 gold marks. 2: *Mythen in der Muttersprache der Pipil von Izalco in El Salvador*. Pp. xii+364+12 plates. 32 gold marks. (Jena: Gustav Fischer, 1933 and 1935.)

THESE two volumes give a detailed and comprehensive account of the social and religious life of the natives of the Quiché tribe of Guatemala and the Pipil of Salvador. Though collected in modern times, the legends and observances are obviously survivals from the early days when the great cultural development of the Maya peoples gave rise to the most spectacular architectural achievements of the aboriginal American.

The author collected his information in the native idiom, which is given in full, with a translation into German on the opposite pages. Chapters dealing with the languages, and grammatical notes and full vocabularies complete a work which will be essential not only to all students of early American culture but also to those who specialize in sociology or linguistics. The account of the Maya peoples recorded by the early Spanish chroniclers, notably Landa and Cogolludo, and the native traditions preserved in the *Popol Vuh* and the books of Chilán Balam will probably be easier of interpretation when re-read in the light of Dr. Schultze Jena's detailed account of surviving belief and practice.

The author has put forward no far-reaching theories, but has simply placed a vast material in the most admirable form, at the disposal of anthropological students. From this point of view, his two volumes constitute one of the most notable contributions to American sociology, and also archaeology, produced in recent years. The volumes are admirably illustrated with photographs of native physical types, scenery and archaeological sites. A short bibliography is appended to each volume. T. A. J.

Exposés de génétique

2: *L'Effet de position et la théorie de l'hérédité*. Par Prof. Th. Dobzhansky. (*Actualités scientifiques et industrielles*, 410.) Pp. 38. (Paris: Hermann et Cie., 1936.) 12 francs.

BEGINNING with a short statement of corpuscular theories of the germ-plasm, the author classifies chromosomal aberrations into changes of (a) the number of chromosomes, (b) the number of genes in a chromosome, (c) the linear order of the genes. The bar-eye gene of *Drosophila* is then discussed on the basis of gene duplication. Other topics considered are (1) the relation between a chromosome break and the dominance of the neighbouring genes, (2) visible mutations appearing at the point of breakage, and (3) reversibility of the position effect. It is concluded that the existence of a position effect is proved. The functioning of a gene is therefore determined not only by its own structure but also by that of neighbouring genes. A gene can therefore be modified by its transfer to a new position, and the position effect can be used in order to investigate the first stages of the action of a gene in development.

What is Osteopathy?

By Drs. Charles Hill and H. A. Clegg. Pp. xix+217+8 plates. (London: J. M. Dent and Sons, Ltd., 1937.) 7s. 6d. net.

THIS is a searching and pitiless exposure of the claims of osteopathy. The first five chapters deal with the life, theories and practice of Andrew Taylor Still (1828-1917), the founder of osteopathy. His inventive power, we are told, far outstripped any scientific discretion he may have possessed, while the evidence that he possessed any at all is scanty. Modern osteopaths, whose theory and practice are examined in the rest of the work, have done nothing to justify their claim for State registration. Their advanced text-books show, it is said, lack of knowledge of the facts of anatomy and physiology as well as a complete absence of scientific evidence in support of their contentions.

The fundamental doctrine of osteopathy, that the predisposing cause of 90 per cent of diseases is nothing more or less than a strained joint, is in no department of medicine more obviously false than in that of infectious disease, nor is there any support for such a view in the case of other disorders. While the authors do not deny that osteopathic manipulations may do good in certain conditions which respond to manipulative treatment in the skilled hands of manipulative surgeons, they maintain that no patient should have such treatment until his condition has been correctly diagnosed, and that a correct diagnosis is not likely to be made by one who has not had a thorough medical training.

The Road to Oxiana

By Robert Byron. Pp. ix+341+16 plates. London: Macmillan and Co., Ltd., 1937.) 10s. 6d. net.

SUPERFICIALLY, telephone and motor-car may seem to have transformed travel in inner Asia, but all they have done is to speed it up—in some ways only. Fundamentally it remains the same, especially where the human factor acts as grit in the machinery. Hence Mr. Byron failed to reach the Oxus—the objective of his journey. In this journal of travel in the Middle East, the villain of the piece, though not in the final obstruction, is "Mr. Marjoribanks", a synonym for the ruler of Persia, though perhaps this name ought to be interpreted as a generic term for all the many incongruities, restrictions and uncongenial elements which the author encountered in the 'modernized' life of the country. In Afghanistan and among its people Mr. Byron was much more at home, even though political exigencies were invoked to debar him from the riverine frontier of Turkestan. International policy and the British Foreign Office receive treatment which the author considers their due.

This lively and entertaining record of personal experiences—in Palestine and Syria as well as in Persia and Afghanistan—is varied by excellent appreciative notes on the architectural features of the more important historical monuments. These are illustrated by a number of photographs which are both beautiful and informative.

The Seventeenth International Geological Congress

"Science is called Science just because it recognises no fetishes, and does not fear to raise its hand against everything that is obsolete and dying, and attentively listens to the voice of Experience, of Practice."—STALIN.

THE decision made at Washington, D.C., in 1933, accepting the invitation of the Government of the U.S.S.R. to hold the seventeenth International Geological Congress in Russia, was received with pleasure by geologists all over the world; and, as a consequence, the meetings at Moscow and Leningrad, which began on July 21 last, were well attended from abroad. The preparations were on a scale that has rarely, if ever, been exceeded, and every opportunity was given to foreign geologists to appreciate the resources of the Union, and the work that had been accomplished by Russian research workers.

The general attitude towards science, in Russia, is clearly exemplified in the quotation from Stalin that heads this article—a quotation that was translated into all the official languages of the Congress, and displayed on each side of the rostrum in the general meeting room. But the attitude towards, and intense interest in, geology, in particular, had to be experienced to be believed; and contrasted most strikingly with the general lack of knowledge in Great Britain of what that science is doing, and has done, for the nation. Geology, to the Russian, stands not merely for the means by which the natural mineral resources of this country may be explored, but also for the means by which his mind can be enlarged beyond the possibilities offered by other sciences. It was not surprising, therefore, to learn that there were about eight hundred Russian members of the Congress.

The language difficulties were overcome in a most excellent manner; for the general meeting room—the Moscow State Conservatory—was fitted up with head-phones, so that the delegates could receive a running translation of the speech of the particular delegate at the rostrum in any of the official languages of the Congress. Some difficulties certainly arose, for the interpreters were not all technical experts, but the ease with which the great bulk of the communications could be followed was remarkable. In the several sectional meeting rooms, official interpreters gave similar services, though the results were not usually so effective. Nevertheless, these services made the Congress a memorable one by relieving the strain

of following papers in foreign languages, and so rendering the meeting more interesting and enjoyable.

The programme for the Congress consisted of some ten major topics; and, of these, the opening meeting considered the problems of petroleum and the world resources of this material. A paper by the president, Dr. I. M. Goubkin, on the estimation of the oil resources of the U.S.S.R., opened the discussions. Subsequent papers covered the several suggested modes of origin of petroleum in the oil-fields of the world; and estimates of oil resources in many areas were presented. Criticism of the figures given for potential supplies was not wanting, but the consensus of opinion tended to a less pessimistic view of the world situation, though quite recognizing that the resources were being rapidly dissipated. Theories of oil production from vegetable and animal matter by bacterial action, from methane by ionization produced by radioactive elements, from coal and oil shale by destructive distillation due to volcanic action, were all advocated as possible modes of origin of petroleum; but the bulk of the communications centred round the tectonics of the several fields described.

The geology of coalfields introduced fewer speculative topics. Again, however, the geological surveying of fields, and the determination of hidden fields in the U.S.S.R., constituted the main themes of the communications; in addition, coalfields in Japan, French Morocco and other regions were described. Methods of correlation of coal seams, and especially the most recent that depend on the examination of the spores and pollen in the individual coal beds, were illustrated by several papers. A particularly interesting communication discussed the structures of anthracites as shown in polarized light. The method had been first proposed by the Chinese geologist Si.

The mineral resources of the U.S.S.R. were still further delineated in the communications relating to Pre-Cambrian rocks, and ore deposits in other formations. These ranged throughout the whole territory of the State, from the Kola peninsula to farthest Siberia, from the Caucasus to the Arctic. While some of these resources have been known for many years, new deposits have come to light during the past two decades, and some of these were very striking. Of special interest to the microscopist was the discovery, in Siberia, of large crystals of optically clear fluor spar. Some of the crystals were cubes with an edge length of

from 4 to 6 inches. They are the largest crystals of colourless fluor spar which have ever been found.

Historically, the geological formation most closely associated with Russia is the Permian System. It is little wonder that problems relating to these rocks should have constituted a considerable part of the proceedings; and, among the most striking of the exhibits arranged for the Congress was a gallery in the Palæozoological Institute of the Academy of Sciences, Moscow, containing the mounted skeletons of herbivorous and carnivorous Pareiasaurians from Permian strata. In *Inostrancevia*, the Pareiasaurian equivalent of *Smilodon* (the sabre-toothed tiger from Pleistocene deposits), there is an example of parallel development that could scarcely be bettered in the whole palæontological record. The teeth of this carnivore attained a length of 10 inches in the specimens on exhibit. This whole exhibit rivals that of the *Smilodon* Gallery in the Museum at Los Angeles, California.

No less striking and fascinating was the exhibit of the Pleistocene mammoth and the woolly rhinoceros in the Zoological Museum at Leningrad. It was common knowledge to geologists that this unique exhibit was to be seen at Leningrad; but it was not known to the majority of the excellent guide-lecturers provided by the Intourist agency at Leningrad. There was some amusing consternation when the suggestions of trips to the Hermitage, the Winter Palace, Peter and Paul Fortress, etc., were emphatically rejected by the visiting geologists, and equally emphatic demands to see 'The Mammoth' were made in every language available to the delegates. The guides were distinctly nonplussed for the moment; but the position was soon straightened out and the pilgrimage to 'The Mammoth' organized.

University departments in geology, in Leningrad and Moscow, were also made available for visits, and among these the Fedorovsky Institute of Economic Mineralogy at Moscow afforded an excellent example of the teaching facilities, and apparatus, available for the Russian mineralogist. The Institute contains probably the most complete and up-to-date range of instruments for mineral research in the world. Prof. Fedorovsky and his assistants demonstrated the methods and technique to parties of those interested. In making mention of this Institute it must not be forgotten that all the other museums were equally generous in affording facilities for the visiting geologists; but it happens that Prof. Fedorovsky was a personal friend of the author of this article, and hence the latter was specially interested in that department. Indeed, it is no exaggeration to say that the preparations made at these several

museums and institutes far exceeded those made for any former International Geological Congress. The preparations were nation-wide, and specimens brought from practically every district of the U.S.S.R.; certainly from every part where specimens of geological interest could be obtained.

Mention must be made of the many social entertainments organized for the Congress. The banquet in the Kremlin, given by the Government, and attended by many of the chief officers of the State, will always remain the central social event of the Congress: but no less memorable were those given by the Academy of Sciences; the Soviet Committees of Moscow and Leningrad; and the Society of Cultural Relations with Foreign Countries. Nor must the numerous banquets organized for the entertainment of the participants on the several excursions be omitted. Wherever these excursions were held, unstinted kindness was lavished on the members of the Congress. Banners of welcome were made ready and displayed; and invitations freely given to visit local places likely to be of interest. A banquet generally terminated the proceedings.

On the excursion to Novaya Zemlya the Soviet Committees of Archangel and Tuloma (near Murmansk) arranged visits and banquets at which the writer was present; even at the wireless stations and settlements in Novaya Zemlya, that far-flung outpost of the U.S.S.R., such entertainments as were possible were arranged.

When one considers the enormous strides that Russian geological science has made during the present regime, it is little wonder if a note of laudation of that regime was evident; and, while political fervour sometimes became prominent, and a little disconcerting to people unaccustomed to such, the reasons for the enthusiasm could easily be understood.

Among the most important of the activities of the International Geological Congress are the excursions. Five were arranged before the Congress and five took place at the close. It was, of course, impossible to attend more than two of these; but for many members only one could be managed in the time available. The writer selected the excursion to Novaya Zemlya, and has had no reason to regret his choice. The party was accommodated on the Soviet steamship *Vologda*; and the navigation around these two islands without adequate charts—for we put into uncharted inlets where places of geological interest occurred—was a tremendous triumph of seamanship on the part of the captain and crew of the vessel. Fortunately, the weather was unusually propitious, and a most ambitious programme completed with practically no alteration, despite the preliminary notice that

the excursion might have to be curtailed. Far from that being the case, it was actually augmented by visits to additional places. The leader, Prof. S. V. Obruchev, was ably assisted by several other members of the Arctic Institute, Leningrad, and by official interpreters. The Lower Palæozoic rocks of this Arctic province were examined, and collections of the most common rocks and fossils were made. The glaciers of the region furnished opportunities of studying many problems of ice-action; while intrusions of acid and basic igneous magma gave scope to those more interested in petrology.

The other excursions were doubtless as interesting, but the writer can only touch on the one he attended.

In conclusion, a word of congratulation must be accorded to the authors and editors of the twenty-five guide books for the excursions, and

the beautiful geological map of the U.S.S.R. on the scale 1 : 5,000,000. The former were published in Russian, French and English, and represent an amount of organization, preparation and editing never before attempted for a geological congress. The map, also, is an achievement that cannot be too highly praised.

Taken all in all, the Congress will be a memorable one for those who took part in it, and the *Comptes rendus*, and other publications, will show those unable to attend the enormous amount of work that has been done, in recent years, in every branch of geology by our Russian colleagues.

It was agreed at the close of the Congress to accept the invitation to hold the Eighteenth Congress in Great Britain; and already steps have been made by the Geological Society for the meetings to be held in London in 1940. W. T. GORDON.

Planning the Land of Britain

APPARENTLY for the first time in the course of its hundred and six years of existence, no fewer than seven sections of the British Association united in a joint discussion on the last evening of the recent Nottingham meeting. The subject was "Planning the Land of Britain" and the chairman was Lord Trent. Symposium would be a more apt description than discussion, for there was no time for any discussion after the seven sectional representatives had each delivered his contribution. The result, however, was instructive; it became very clear that each of the sciences has a definite contribution to make to the general problem, but that there is a considerable divergence both in point of view and objective—differences which point the need for further discussion.

Dr. L. Dudley Stamp, director of the Land Utilization Survey of Britain, in his opening paper, attempted to stress some of the fundamental considerations underlying planning. In the first place, any planning must start from the present position, for the present utilization of the surface of Britain is the result of two or three thousand years of settlement, of a long-continued process of discovery by trial and error and of the play and interplay of a variety of factors. The isolation and intensive study of those factors must surely be the first requirement, for any planning contrary to the dictates of long-term trends and natural controls must surely end in failure. In the first place, there are the *natural* or *geographical factors* of position and accessibility, physical build and geological structure, soil and climate, all of

which impose strict limitations on land use. They emphasize the essential contrasts between the predominantly moor-covered highland Britain of the north and west with pastoral, agricultural and industrial Britain of the south and east. Insufficient is known of Britain's soils, but the limited resources of first-class soil are certain. With the improvement of transport and communications, it is easy to supply even the remoter settlements with the needs of everyday life, so that there is no longer any necessity for the semi-subsistence type of agriculture so prevalent in the past—as with the Scottish crofter. Consequently the incidence of the natural factors in determining land use is greater than ever before. In the second place, the *historical factors* often result in a stabilizing of land use—many of the parks, forests and common lands so valued to-day for amenity reasons are legacies from days when the reasons for their creation were entirely different. In the third place, the *economic factors* are clearly the most important in determining changes within the limits permitted by natural factors. A study of a large number of parishes in different parts of Britain over a hundred years or more shows a remarkable stability of land use on the best land (arable farming) and on the poorest land (heathland or woodland), and a maximum change on land of intermediate quality.

The incidence of geological factors in planning is both direct and indirect. The direct influence of coalfields and ore deposits on industry and land use is obvious; so also is the negative influence of

great areas of hard ancient rock, but Prof. P. G. H. Boswell (Section C) was concerned to stress the important indirect influences, especially through water supply. If the geologist is concerned with factors which are omnipresent but static, the zoologist and botanist deal with factors which are essentially both ubiquitous and dynamic. It is quite impossible to preserve 'typical' tracts of Britain by isolating them as national parks. The vegetation which is the chief attraction of our chalk downland or our scrubby heathland is essentially ephemeral—all these seral communities will change rapidly to woodland unless deliberately preserved in their present form. On the other hand, the 'management' of woodland of necessity destroys the decaying timber, which is the home of a characteristic fauna and flora. Each case must be decided on its individual merits, and the detailed knowledge of the scientific worker is needed. There is a real danger in the preservation of small beauty spots in that the concentrated pressure of human population quickly destroys both flora and fauna. Prof. E. J. Salisbury and Dr. Julian Huxley were in obvious accord on these points, though the latter was also concerned with the provision of Nature reserves in remoter areas in which wild life could adapt itself to present or changing vegetation.

We are accustomed to associate the charm of rural England with its old and picturesque cottages, perhaps forgetting that the cottages would lose most of their charm if removed from the setting of the old cottage garden. Although gardens in aggregate only occupy some two per cent of the surface of Britain, their influence on the scenery and indeed on the whole life of the country is out of all proportion to this area. The 'standardization' of gardens may be more fatal than the standardization of rows of houses all alike, since it should be the function of the garden to provide both individuality and variety. Since most houses are on roads, this is the more important in that the traveller sees more of England's gardens than of any other aspect of land use for amenity purposes.

Sir Daniel Hall spoke as the protagonist of a depressed industry and he claimed that his 'depressed area'—the farming lands of Britain—occupied the bulk of the country. He clearly considered the modern trend to be to think too much of recreation and too little of the serious work of the countryside, though the hiker might have an important economic importance to the small farmer by his requests for accommodation and food. As he was leaving the platform, Sir Daniel threw the bomb of the evening amongst the audience when he claimed that the reorganization needed by agriculture could only be accomplished

with the State ownership of land. In a later letter to *The Times* (Sept. 24) he urges that although the farmer may know what best suits his land, it does not follow that he knows what best suits the national interest. The conditions in Fenland are such as to make this the area which, above all others in Britain, should be devoted to fruit and vegetables. Is it to the national interest that a quarter of the land should be, as it is at present, devoted to wheat, simply because the local farmer is encouraged by the wheat quota? Our leading agriculturists are clearly divided on the question of land ownership. Prof. R. G. Stapledon would agree with Sir Daniel, but many doubt whether there are sufficient numbers of experts of their calibre to direct a State-owned Britain. G. M. Young visualizes "Some Board of Experts, all fighting like cats, staffed by tired examinees aspiring to become successful officials".

Unfortunately for Britain, agriculture seems to have few contacts with forestry, nor has the forester been conspicuous in his regard for agriculture. Sir Roy Robinson expressed pride at the achievements of the Forestry Commission—the sole post-War plan to move steadily to its appointed goal. Sir Roy spoke rather as a dictator, and it may be that the widespread opposition to the work of the Commission from landowners, sportsmen and those who seek so conservatively to preserve the countryside as it is at present, is based on a hatred of a relentless prosecution of a most desirable and nationally important objective. But it bodes ill for the success of a national plan for agriculture or indeed for any single demand on the land. Surely it is co-operation which should be the keynote of any land planning.

No family has done more to develop and beautify the local city than has the family of Boot in Nottingham, and it was accordingly of interest to hear Lord Trent say that individual efforts have already done as much as possible, and that the next move is with the State. He was alive to the practical difficulties of planning, just as Prof. J. H. Jones as an economist was concerned to stress the wider and deeper aspects of planning and the difficulties involved. What is the object of planning? We cannot plan without being sure of our objective, and it must be decided whether the object of planning is social, economic or strategic. The planning of industry is identical with the planning of land, and this is a truth which it is hoped the Royal Commission on the Siting of Industry will not overlook. It is surely the duty of the scientific community to maintain a permanent committee amongst themselves and to present a considered, if not unanimous, opinion on all aspects of the land and its future. L. D. S.

A New Conception of Supraconductivity

By F. London, Institut Henri Poincaré, Paris

IN the past few years, physicists have been much engaged by the phenomenon of supraconductivity. It is well known that various metals, when cooled below a certain very low temperature, characteristic of the metal in question, show the strange property of conducting electricity apparently without offering any resistance to the current. This curious phenomenon seems to contradict all our customary conceptions in physics. Particularly striking was the experiment of Kamerlingh Onnes and Tuyn, in which a current was induced in a supraconducting ring of lead and was found to persist there without any measurable decrease for many hours—so long as the low temperature could be maintained. This experiment seems to present a unique case of motion without any friction, whilst we have been accustomed to see in every mechanism an occasion for dissipation of kinetic energy into heat.

1. Attempts have been made to explain this phenomenon by various mechanisms. But in all of them the same type of difficulty is always encountered. As in an ordinary conductor, so in a supraconductor, it seems necessary to imagine an enormous number of different electronic states corresponding to the infinite number of different currents possible in it, different as regards direction and intensity. But on the other hand, it seems very difficult to comprehend why in these states the motion of the electrons should not be damped, that is, why the electronic waves should not be dispersed. One would imagine that in any event the interaction with the ionic lattice would cause transitions between these numerous electronic states favouring the passage to states of less energy and less intensity of current. In a short time the irregularity of the thermal vibrations of the lattice should effect a complete dissipation of the initial current.

This difficulty still appeared aggravated when Bloch adduced a very general argument according to which the most stable state of a mechanism of electrons under rather general conditions cannot show any current if no external field is applied.

It can be said that all who have tried to construct a theoretical picture of a supraconductor have been completely baffled by this dilemma.

The new conception I have developed in different papers, partly in collaboration with H. London¹, differs essentially from the earlier attempts in so far as it exhibits the possibility of representing

all supracurrents realizable in a simply connected supraconductor by even one single electronic state alone; though to be sure, the presence of an external field has been found to be of fundamental importance.

A new experiment has given us the key to this possibility. Meissner and Ochsenfeld² found in 1933, that a supraconductor behaves not only like an ideal conductor, but in addition also like a very strongly diamagnetic metal. According to the Maxwell equations, an ideal conductor would not show any change of magnetic flux in its interior; this signifies that one should find, so to speak, 'frozen in', that magnetic field which was present at the moment when the supraconductivity was established. Meissner's experiment, however, has shown that in a supraconductor the magnetic flux is always equal to zero. It has been observed that those magnetic fields, present before the supraconductivity was established, are pushed out while the temperature is lowered below the transition point (provided the experiment is carried out under 'ideal' conditions; see further below).

According to Meissner's experiment, it looks as though the transition from the non-supraconducting to the supraconducting state in a magnetic field is *reversible*, so far as the magnetic flux can always be considered as equal to zero in any volume element in the supraconducting state *independently of the way* in which the transition temperature has been passed. That is quite different from the case of infinite conductivity. There the transition is not reversible and the supraconductor would show a kind of permanent memory of that magnetic field which was present when supraconductivity was last established. The point of view, that *the transition into the supraconducting state is a reversible phase transformation*, was already suggested by Rutgers and Gorter³, who, starting from this assumption of reversibility, derived certain thermodynamical relations between specific heat, magnetocaloric effect, etc., relations which have been verified in the meantime by many experimenters.

2. This state of affairs suggested an interpretation of supraconductivity which is entirely different from that which considers this phenomenon as a limiting case of ordinary conductivity. Though it is not possible to consider the diamagnetic phenomenon as a consequence of the infinite conductivity, the converse can to a certain extent be done.

A diamagnetic atom, as is well known, exhibits the possibility of permanent currents flowing in a system which is in its most stable state. These currents, indeed, do not appear except in the presence of a magnetic field, and that is precisely the reason why this mechanism is not covered by the theorem of Bloch mentioned above; for Bloch's theorem deals only with systems with no external field.

Let us for a moment consider the behaviour of a diamagnetic atom in a magnetic field. We may describe such an atom by the following properties:

(a) Its lowest state is not degenerate and belongs to the discontinuous spectrum. Its wave function is real.

(b) In a weak magnetic field h , the wave function ψ does not experience stronger perturbations than those proportional to the square of h or still higher powers of h :

$$\psi = \psi_0 + h^2 \psi_2; \quad (1)$$

where ψ_0 is the wave function for $h = 0$.

In the (non-relativistic) wave mechanics, the density of current j of an electron in the state ψ is known to be given by the formula:

$$j = \frac{he}{4\pi im} (\psi^* \text{grad } \psi - \psi \text{grad } \psi^*) - \frac{e^2}{mc} \psi \psi^* \mathbf{A} \quad (2)$$

where h , m , e , c are the well-known universal constants, ψ^* is the conjugate complex value of ψ and \mathbf{A} is the vector potential of the magnetic field h ($h = \text{curl } \mathbf{A}$).

Substituting into this expression the above ψ of the diamagnetic atom, one obviously obtains as the greatest term, the only one proportional to the field strength:

$$j = -\frac{e^2}{mc} \psi_0^2 \mathbf{A} + \dots \quad (3)$$

All the other terms are of the order h^2 or still smaller. Calculating the moment of this current, one obtains the well-known expression for the induced diamagnetic moment of the atom.

It is perhaps of some interest to discuss in more detail how the diamagnetic atom succeeds in representing an *infinite number of currents by one single state*.

In a magnetic field the total momentum \mathbf{p} of an electron is not simply proportional to the velocity \mathbf{v} ; it is rather

$$\mathbf{p} = m\mathbf{v} + \frac{e}{c} \mathbf{A} \quad (4)$$

This formula can be considered as the supplement to the well-known analogous resolution of the energy into 'kinetic' plus 'potential' energy, and accordingly the two terms $m\mathbf{v}$ and $\frac{e}{c} \mathbf{A}$ are sometimes distinguished as 'kinetic' and 'potential' momentum.

The formula (2) for the current is obviously based on the corresponding resolution of the velocity \mathbf{v} equivalent to (4):

$$\mathbf{v} = \frac{1}{m} \mathbf{p} - \frac{e}{mc} \mathbf{A} \quad (4')$$

For the term $(h/4\pi i) (\psi^* \text{grad } \psi - \psi \text{grad } \psi^*)$ in (2) represents the local density of the total momentum \mathbf{p} in the state ψ . (This can easily be verified by putting, for example, a plane wave $e^{2\pi i \mathbf{p} \cdot \mathbf{r}/h}$ into this term.) It is a somewhat strange but quite characteristic feature of the wave-mechanical description that the wave-length of the de Broglie waves does correspond to the *total momentum* ($p = h/\lambda$) and *not to the kinetic momentum*, whereas the latter, being proportional to \mathbf{v} , is attached to the current. (Correspondingly the frequency is known to be attached to the total energy ($E = h\nu$) and not to the kinetic energy.)

Now, owing to equation (1), in a diamagnetic atom the term $(h/4\pi i) (\psi^* \text{grad } \psi - \psi \text{grad } \psi^*)$ representing the mean total momentum \mathbf{p} remains everywhere practically zero, even in a magnetic field. In this case the currents occurring are, so to speak, a kind of image of the actual magnetic field. The local kinetic momentum, that is, the local current, given by (3), is throughout equal but opposite to the local potential momentum, represented by the vector potential of the magnetic field, so that the sum of both, \mathbf{p} , is everywhere zero. In such a manner a diamagnetic atom in its one lowest state can show an infinite variety of different currents corresponding to the infinite variety of orientations and intensities of the applied magnetic fields, whereas its wave function does not show any appreciable reaction.

This mechanism of conduction is entirely different from that considered in the customary theories of conductivity: the transport of electricity is *not* based, as usually, on *progressive waves* (or progressive wave packets), but on *stationary waves*. By these a transport of electricity can only be effected in the *presence of a magnetic field* and this is precisely our assertion as to the nature of the supracurrents.

3. Let us now assume that in a simply connected superconducting metal there may be one or several discrete electronic states of the same properties (a) and (b) below the continuum of ordinary (Bloch-) states. Since in all these states by a given magnetic field practically the same current is evoked, the transitions between these states caused by the interaction with the lattice vibrations will effect no dissipation of the diamagnetic currents. This is exactly the mechanism by which the interaction with the nuclear vibrations in a diamagnetic molecule is prevented from effecting any dissipation of the diamagnetic currents evoked by an external magnetic field.

Thus for a supraconducting electron also we will suppose the same equation (3) to be valid :

$$\mathbf{j} = -\frac{e^2}{mc}\psi_0^2\mathbf{A};$$

where ψ_0^2 signifies the probability of finding this electron, which we will suppose to be practically constant throughout the metal. Summing over all electrons, we therefore obtain for the density of the total current :

$$\mathbf{J} = -\frac{e^2n}{mc}\mathbf{A} = -\frac{1}{\Lambda c}\mathbf{A} \quad (5)$$

where n signifies the number of supraconducting electrons per cm.³. $\Lambda = m/ne^2$ is a constant of the dimensions [sec.²] characteristic of the supraconductor in question. As $n \leq 10^{22}$, one obtains $\Lambda \geq 3.2 \times 10^{-22}$ sec.².

The vector potential not being uniquely defined has yet to be normalized in a definite way in order to obtain in (5) an unambiguous statement. We can, however, get rid of this ambiguity by forming the curl of (5) and obtain

$$\Lambda c \cdot \text{curl } \mathbf{J} = -\mathbf{h} \quad (6)$$

This is the fundamental macroscopic connexion between magnetic field \mathbf{h} and current density \mathbf{J} that we propose for the supraconducting state.

From our observations apropos of the diamagnetic atom, we may infer that in our model the notorious difficulties discussed above will not appear. Compared with the former conception of infinite conductivity the assumptions (a) and (b) certainly signify an appreciable *reduction* of the mechanism which remains to be explained by the theory of electrons. On the other hand, (a) and (b) form, of course, in no way a necessary basis of (6), and it is quite possible that the future development of the molecular theory will replace them by a still more reduced basis⁴.

4. In the following we shall discuss the *macroscopic description* furnished by (6). The currents which are admitted by this equation are very far from being identical with those which would correspond to an infinite conductivity. *The variety of possible currents is considerably more restricted* according to our interpretation, which admits *only currents, which are correlated in a very special manner with a magnetic field*. But it can be shown that it is really possible by just this restricted ensemble of currents to describe all the supracurrents which are actually observed.

Applying the Maxwell equation

$$c \text{ curl } \mathbf{h} = \mathbf{J}, \quad (7)$$

(neglecting here the displacement current) we can eliminate \mathbf{J} in (6) and (7) and get

$$c^2 \Lambda \text{ curl curl } \mathbf{h} = -\mathbf{h};$$

or since $\text{div } \mathbf{h} = 0$

$$c^2 \Lambda \nabla^2 \mathbf{h} = \mathbf{h} \quad (8)$$

This equation indicates that the magnetic field decreases exponentially from the surface to the interior of the supraconductor, in this way representing the Meissner effect. As in a diamagnetic atom, the induced currents behave like a screen; their magnetic field tends to diminish the original field. In a distance of the order of magnitude $\gg c\sqrt{\Lambda}$ ($\gg 10^{-5}$ cm.) the field can be considered as practically zero.

In Meissner's experiment, it is obviously the applied external magnetic field which evokes the supracurrent as soon as the supraconducting state is established. In the case of the permanent current in a ring (and also in the case of an open wire which is fed by normal conducting leads), the magnetic field which *maintains the current* proves to be *identical* with that which is *produced by the current* itself. The most stable state of a ring has no current, unless an external magnetic field is applied. To be sure, the states in which the ring possesses a permanent flux through its central hole, are not states of lowest energy but are *metastable under macroscopical conditions*: only by a *finite* variation of the macroscopic parameters of the system (for example, by passing the transition temperature or by cutting the ring open) can the ring be brought into the absolutely stable state which contains no flux.

To complete this theory it is necessary to add to (6) a further statement as to the behaviour of the electric field. In this regard the magnetic equation (6) as well as experience do not exclude a certain indeterminateness, and an experiment had, therefore, to be arranged in order to elucidate this point⁵. We cannot enter here into a detailed discussion of this question, and want only to state that as a result of this experiment the relation

$$\Lambda \dot{\mathbf{J}} = \mathbf{e} \quad (9)$$

(\mathbf{e} being the electric field strength) seems now to be the most simple formulation of this supplementary electric equation. The electric fields possible according to (9) and (6) are reduced to just those which are inseparably attached by induction to the magnetic field. The equation (9) simply states that there are no other currents in the supraconductor than those which, according to (6), are evoked and maintained by the magnetic field.

It might be emphasized that our conception differs essentially from a description which has sometimes been given, according to which supraconductivity should be characterized by the particular value $\mu = 0$ of the magnetic permeability. Though for simply connected isolated supraconductors both formulations give macroscopically

identical results, they prove entirely different if one has to deal with supraconducting rings.

The essential characteristic of our theory can be seen in the following: The same relation (6), between current and magnetic field, which represents the Meissner effect and which for simply connected supraconductors is practically identical with the description $\mu = 0$, is able, moreover, to describe the distribution of the permanent currents in supraconducting rings. The magnetic field of these rings, having a curl, requires, according to Maxwell's theory, the explicit introduction of the

macroscopic current. It cannot, of course, be described by a particular value of the magnetic permeability only.

¹ London, F. and H., *Physica*, 2, 341 (1935). London, F., *Proc. Roy. Soc., A*, 152, 24 (1935). Comprehensive report: "Une conception nouvelle de la supra-conductibilité", *Actualités scientifiques et Industrielles* No. 458 (Hermann et Cie., Paris, 1937.)

² Meissner, W., and Ochsenfeld, R., *Naturwissenschaften*, 21, 787 (1933); Meissner, W., and Heldenreich, T., *Phys. Z.*, 37, 449 (1936).

³ Appendix to Ehrenfest, P., *Leiden Comm. Suppl.*, 756 (1933). Gorter, C. J., *Arch. Mus. Teyler*, 7, 373 (1933).

⁴ London, F., *C.R.*, 206, 28 (1937).

⁵ London, H., *Proc. Roy. Soc., A*, 155, 102 (1936). See also v. Laue, M., London, F. and H., *Z. Phys.*, 96, 359 (1935). Schrödinger, E., *NATURE*, 127, 824 (1930).

[To be continued.]

Obituary Notices

Dr. J. R. Airey

DR. JOHN ROBINSON AIREY died in his seventieth year at his home in Newtown, Montgomeryshire, on September 16, after an illness lasting more than six months. He was a native of Leeds, where he received his early education at the Blenheim Council School and the Central High School. After serving as an assistant in the science department of the latter he was, from 1896 until 1903, a master at the Porth County School, Glamorganshire.

Airey's first degree was a London B.Sc. in 1894. In 1903 he interrupted his teaching work for three years, and went up to St. John's College, Cambridge, as a foundation scholar; he took first-class honours in both parts of the Natural Science Tripos, and was awarded the Wright Hocking and Hughes prizes. From 1906 until 1912 he was principal of Morley Secondary School, and from then until 1918 principal of the West Ham Technical Institute. In that year he became principal of the City of Leeds Training College, where he was held in very high esteem by all with whom he came into contact. On his retirement in 1933 he was presented by his old students with his portrait in oils, which he gave to the College. This was accompanied by an illuminated letter, from which may be quoted "You will live in our memories as a principal and a friend whose words were few and whose happy and kindly disposition shone out so brightly that even your reproofs were tinged with humour". Another friend described him as "a veray parfit gentil knyght".

Airey became a D.Sc. of London in 1915, and in 1926 Cambridge conferred on him its coveted Sc.D. He will be best remembered in scientific circles for his work as a mathematician and computer, particularly in connexion with Bessel functions, in which he was deeply interested for thirty years. He became a member of the British Association Mathematical Tables Committee in 1911 and continued to serve uninterruptedly until his death; from 1918 until 1929 he held the office of secretary. His first published tables appeared in the report of this committee for 1911, and were of the so-called Neumann functions, which are related to the functions usually known as

Y functions or Bessel functions of the second kind; these tables were extended in 1913, 1914 and 1915.

The need for extensive tables of sines and cosines in radian measure to facilitate the rapid calculation of transcendental functions from their asymptotic expansions led Airey to prepare such tables. The first, in 1916, gave these functions to 11 decimals at interval 0.001 throughout the quadrant. 15-figure tables at varying intervals up to $x = 100$ appeared in the Reports for 1916, 1923, 1924 and 1928. These tables were reprinted, with some extensions, in volume 1 of the "British Association Mathematical Tables" in 1931, and are now widely used and appreciated by engineers and mathematical physicists. Since their publication Airey has prepared extensive manuscript tables to 13 decimals at interval 0.0001, but these have not yet been published.

It is not possible to enumerate all the tables computed by Airey of functions related to Bessel functions; a list of them occupies a page in the 1929 Report. It should, however, be mentioned that he made, in 1917, the first extensive calculations of what he called the Lommel-Weber function. Owing to war conditions they were not published until 1924, although mentioned in the reports of the two previous years; meanwhile similar figures appeared in Watson's "Theory of Bessel Functions" under the name of Struve function.

In 1918 Webb and Airey directed attention, in a paper in the *Philosophical Magazine*, to the importance of the confluent hypergeometric functions in the solution of a wide range of differential equations of the second order. This was followed, in the British Association Reports for 1926 and 1927, by tables of these functions for various values of the three arguments on which they depend.

The second volume of the "British Association Mathematical Tables", giving solutions of Emden's equation, is based entirely on methods suggested by Airey. He was, in fact, a master of the art of getting numerical solutions of equations that would not yield to formal treatment. In particular, he was conspicuously successful in dealing with asymptotic series, where the common practice is to compute to

the least term, and neglect the divergent part. He had the happy knack of discovering the form of 'converging factors', which, when multiplied by the least term, gave the effect of the divergent terms; in this way he was usually able to double the number of decimals that could otherwise be obtained.

Another phase of Airey's activity was his association with the production of the *Philosophical Magazine*, which goes back many years. In 1933 his name first appeared on the journal as a joint editor, and from that date onwards he read and passed for press every article. Although not a frequent contributor in recent years, his last task was the reading and correction of an article by himself, which will appear in a future number.

Airey was a fellow of the Royal Astronomical Society, the Physical Society and the Edinburgh Mathematical Society. He will be remembered as an inspiring colleague, and a friend who was always generous with his help. He is survived by a widow and a daughter.

L. J. COMRIE.

Mr. W. B. Ferguson, K.C.

WILLIAM BATES FERGUSON, who died on Thursday, October 7, in his eighty-fifth year, was educated at Manchester Grammar School and Merton College, Oxford, where in 1874 he graduated with first-class honours in natural science. At this time it was apparently his intention to enter the medical profession, but after another year or two engaged in study and lecturing, during which he became one of the original fellows of the newly founded Institute of Chemistry, he qualified for the Bar, to which he was called in 1882. He practised for some eighteen years and took silk in 1900, but then on urgent medical advice had to give up his profession and retire for several years to Arosa in Switzerland.

Ferguson was already keenly interested in photography, and having become a member of the Royal Photographic Society in 1895, was elected a fellow in 1900, in which year he published a paper on toning prints and slides with copper compounds. While at Arosa, in collaboration with B. F. Howard, he studied the influence of temperature on the rate of development of dry plates and devised his time-temperature system of compensating therefor, which has proved of permanent value. He was a close student of Hurter and Driffeld's epoch-making researches, and the design of photometers for the measurement of photographic densities became one of his hobbies. His outstanding contribution to photographic science was undoubtedly the Hurter and Driffeld memorial volume, in which he not only collected together in conveniently accessible form all their important papers, but also gave us the results of a painstaking study of their apparatus, laboratory notebooks and correspondence, a labour of love which occupied him for fully two years.

Ferguson's striking figure and charm of manner will not soon be forgotten by members of the Royal Photographic Society, and many are indebted to him for his unfailing interest and kindly encouragement in their work. Although repeatedly invited to become

its president, his precarious health always compelled him to decline, but on the Council and in numerous committees he served the best interests of the Society for many years. He was awarded the Society's honorary fellowship and the Progress Medal in 1914, the Hurter and Driffeld Memorial Medal in 1918 and the Davanne Medal of the Société Française de Photographie in 1925, in recognition of his scientific work, and was throughout its existence a vice-president of the British Photographic Research Association. All who knew him will mourn the loss of a good friend and an outstanding personality, and will deeply sympathize with his wife and family in their sorrow.

F. F. R.

Dr. Carl Spengler

By the death on September 16 of Dr. Carl Spengler in his seventy-seventh year, one of the pioneers of tuberculosis research and treatment has passed away. He lived and died at Davos, and was one of those who made Davos the first, and for a time the chief, centre for the Alpine treatment of pulmonary tuberculosis.

Carl Spengler studied medicine at Heidelberg and Zurich, afterwards worked at bacteriology under Profs. von Stilling and de Bary, and from 1886 until 1889 was assistant physician in the University of Strassburg. He then returned to Davos in order to specialize on tuberculosis, and his work attracted the attention of Robert Koch, with whom he collaborated for a time, originating the preparation of tuberculins from the bovine type of bacillus, and devising the method of administering tuberculins now in general use. He also devised a special technique for demonstrating the tubercle bacillus, which still remains one of the best of the staining methods, and described the presence in tuberculous materials of spheroidal bodies derived from the tubercle bacillus, which he termed 'splitter' bodies, and the appearance of which he regarded as being of favourable import as indicating disintegration of the tubercle bacilli.

In addition to developing the climatic and open-air treatment of tuberculosis, Spengler also sought to discover an agent which would exert a curative action upon tuberculosis by the possession of lytic and antitoxic properties towards the tubercle bacillus. This he claimed to have done, and evolved his *I.K.* (= *Immun Körper*) treatment for the disease. He believed that the red blood corpuscles (and not the serum) of a specially immunized animal carry the bulk of the immunizing substances, and devised his *I.K.* remedy for treatment, which consists essentially of a solution of the anti-tuberculous immunizing bodies derived from the red blood corpuscles of a treated animal. He also applied the same methods in the treatment of other diseases, and during his last years devoted much time to research on cancer.

R. T. HEWLETT.

We regret to announce the death of the Right Hon. Sir Herbert Maxwell, Bt., K.T., F.R.S., chairman of the Royal Commission on Ancient Monuments (Scotland) in 1908-34, on October 30, aged ninety-two years.

News and Views

Prof. A. von Szent-Györgyi: Nobel Prize for Medicine

It is announced by the Stockholm correspondent of *The Times* that the Nobel Prize for Medicine for 1937 has been awarded to Prof. Albert von Szent-Györgyi, of the University of Szeged, in Hungary, for his work on vitamin C. More than fifteen years ago, experiments carried out by Szent-Györgyi on the adrenalectomized animal suggested to him that the adrenal cortex is in some way involved in biological oxidation. A detailed study of different animal, vegetable and synthetic oxidizing systems was made, but no connexion could be found between these and the function of the adrenal cortex. However, nine years ago, evidence was obtained that the cortex is in some way connected with the peroxidase system and at the same time a reducing substance, considered to be a 'hexuronic acid', was isolated from it. The same acid was also found in plants and shown to be an essential part of the 'reducing factor' of plant juices, being apparently connected with the function of the peroxidase system. Since the 'reducing factor' is found in fruit juices which contain vitamin C and cure both human and experimental scurvy, the antiscorbutic potency of the 'hexuronic acid' was investigated,

HOWEVER, it was not until four years later that Svirbely and Szent-Györgyi were convinced that the potency of this acid was really due to the acid itself and not to its contamination by some more potent substance. Success was dependent on the possibility of obtaining large quantities of the acid, and the authors were finally successful when they discovered that paprika, the Hungarian red pepper, is an unusually rich source. Meanwhile, investigation in various laboratories of the chemical nature of 'hexuronic acid' had necessitated a modification of the structural formula originally proposed and Szent-Györgyi and Haworth (*NATURE*, 131, 24; 1933) suggested the name "ascorbic acid", by which vitamin C is now generally known. It was not long after Szent-Györgyi's isolation of ascorbic acid from natural sources before the vitamin was prepared by chemical synthesis, and the synthetic vitamin is now employed in medicine when large doses are required. Although Szent-Györgyi's brilliant research may have closed a chapter in vitamin chemistry, it has nevertheless opened one in the treatment of disease.

Representation and the Australian Aborigines

To those whose vocation it is to consider the Australian aboriginal mainly, if not exclusively, in a context in which he appears as the most primitive, physically and culturally, among existing peoples, there is something incongruous in the report from Canberra (*The Times*, Oct. 27) that the aborigines have petitioned the King, asking His Majesty, through the Australian Government, to empower them to

propose one of their own people, or a sympathetic white, to represent them in the Federal Parliament. The purpose of the petition, it is stated, is to prevent their extinction. It goes on to point out that the injunction laid on the first settlers in Australia, that the aborigines should be adequately cared for, has not been obeyed, since aborigines' lands have been expropriated and legal status has been denied them. This is the first occasion in Australian history on which such action has been taken by the aborigines; but as the eighteen hundred and fourteen signatories to the petition, drawn from all parts of Australia, are chiefly from mission stations, the circumstances which have determined their mode of action are not beyond conjecture. The petition has been forwarded by Mr. Lyons, as Prime Minister, to Lord Gowrie, the Governor-General, for submission to the King.

WHATEVER may be its ultimate fate, the fact of the submission of the petition is significant. It is one among a number of indications of the profound cultural changes which are taking place among even the least advanced races under Imperial administration. It points to the fact that neither segregation, the provision of reservations, nor even 'indirect rule' are to be regarded as the final solution of the problems which arise in modern conditions out of even the regulated cultural contacts of white and backward civilizations. Cultural change, it seems, is inevitable; but in recent discussion of the colonial question, it appears to be overlooked that under democratic institutions the growth of a native opinion cannot be ignored, and the crux of the colonial problem is not ownership, but the will, as well as the competence, to guide native development in the light of detached and scientific study along lines beneficial to the native himself, as well as to the larger world in which he will have to find his level some day when he emerges from tutelage.

The Progress of Engineering

IN his presidential address to the Institution of Civil Engineers on November 2, Mr. Bryan Donkin pointed out that it is nearly thirty years ago since Siemens and Kennedy, who preceded him in the chair and who were like himself connected with both the mechanical and electrical branches of engineering, described the latest advances which had then been made in the new industry. The intervening gap he filled up most satisfactorily. In an essay on applied science written in 1810, Shelley said of electricity, "What a mighty instrument it would be in the hands of him who knew how to wield it." Shelley referred to the aerial mariner who could swim in the air with bladders and said that such ingenuity was not to be condemned. "Why," he said, "have we not dispatched intrepid aeronauts to cross Africa in every direction to survey the whole peninsula in a few

weeks?" It is by these means "that we could advance civilization, emancipate every slave and improve generally the welfare of mankind." Now most of the things Shelley thought of have been done, and mankind has benefited.

MAN has become a more efficient unit, he performs more work in a given time, he lives longer, he has greater comforts, but with all these advantages, it is a misfortune that the necessity still arises for some to spend their energies and the wealth of their country in fruitless endeavours to kill, or to be ready to kill, their enemy in less time and at less cost than is possible for their adversaries. According to the best authority, it was shown in 1936, by statistics of the cost of various domestic commodities throughout Europe, ranging from electricity to coal and including butter, bread, milk, meat, potatoes and sugar, that the fall in the price of electricity since 1914 was greater than that of any of the others. In addition, the price of electricity in Great Britain had fallen more than in any other country. It is practically certain that it will fall still further. In conclusion, Mr. Donkin quoted with approval Lord Weir, who said that millions of pounds should be spent in research in the political sphere for the founding of a thinking department for the investigation and analysis of human qualities. It should explore the possibility of healing and softening racial bitterness and ultimately demonstrate to the world the utter inability of war to solve political problems.

Co-operation between the Engineering Professions

AT the beginning of his presidential address to the Institution of Electrical Engineers delivered on October 21, Sir George Lee re-echoed Sir Alexander Gibb's suggestion, given in his address to the Institution of Civil Engineers last year, for closer co-operation and co-ordination between the various engineering institutions. The engineering industry is now so large that amalgamation between the various institutions, even if desirable, would be practically impossible. But he made two suggestions of directions in which co-operation should be easy and an advantage to industry. The first was that facilities might be given to members of one institution to attend meetings of other institutions, to hold joint meetings on subjects of common interest and to give special library facilities to all. The second was that the full implications of social science can best be handled from the engineering side by the combined efforts of all the engineering professions. To an increasing extent the lives of our people are bound up with engineering development, and the economics of our welfare are dependent to a large extent upon the rate of this development. The closer association and meeting of people who are interested in different phases of what is actually the same subject would facilitate the recognition of common interests and ideas.

SIR GEORGE then passed on to give an interesting account of developments in some of the activities of the Post Office. He pointed out the success of the

new telephone tariffs. The shilling night rate has been a very successful psychological touch which succeeded beyond the wildest expectations. He laid stress on the difficulties of development forecasting. If a successful forecast is made, then the capital expenditure can be reduced to a minimum. When the sixpenny telegram was introduced in 1935, there was an immediate increase of 34 per cent over the corresponding period for the preceding year. The standardization of teleprinter working has paved the way for the development of a switched telegraph system utilizing the familiar methods of automatic telephony. Probably it will soon be possible for any teleprinter office in the inland service to obtain instant communication with any other teleprinter office simply by dialling.

Nuffield College, Oxford

MORE information relating to the proposed college for research in social studies, to be called Nuffield College (see NATURE of October 23, p. 697), is now available. The erection and equipment of the College and the laying out of its grounds will be in the hands of the governing body of the University, the Hebdomadal Council. It shall from time to time appoint the warden, the fellows and other officers, and generally take charge. It is proposed to have maxima of twelve official fellows, eight faculty fellows, twenty visiting fellows, and forty students. Women will be eligible for fellowships and studentships. The official fellows will be whole-time research workers, the faculty fellows teaching members of other colleges who do work on social studies, and the visiting fellows the possibly non-academic persons from outside. The students will be at least in their third term of residence at the University and working for research degrees. All classes of fellows (but not women fellows) will be entitled to rooms and dinner in college and students may also have rooms there. The visiting fellows and the students will receive honoraria or emoluments of the order of fifty pounds per annum. Lord Nuffield will be the first honorary fellow.

Comets and Problems of Cosmogony

THE presidential address at the British Astronomical Association was delivered on October 27 by the Rev. Dr. M. Davidson. He discussed comets, especially in connexion with the light that they throw on problems of cosmogony. Considering that comets move in orbits of such a diverse nature, direct and retrograde orbits being nearly equal in number, taking comets on the whole, he showed that there are difficulties in reconciling this fact with the tidal theory of the origin of the solar system. He referred to the families of comets which are associated with the major planets, stating that it is quite impossible to explain these on the capture theory. There is, he considers, some basis for the view that they were expelled by the planets, though there are certain objections here also. Various theories for the origin of both the short-period and long-period comets were dealt with in turn; but, Dr. Davidson

pointed out, none of these can be considered satisfactory. Bobrovnikoff's conjecture that the sun captured comets when it was passing through diffuse clouds of obscuring matter less than a million years ago would appear to be mere speculation, and great difficulties arise when we inquire how bodies of such diverse sizes as are found in the nuclei of comets should appear in diffuse clouds of obscuring matter. The whole subject is full of difficulties, and Dr. Davidson contented himself with expressing the hope that posterity would be able to solve the problem. At the close of his address, he presented the Walter Goodacre Gold Medal and Gift to Dr. A. C. D. Crommelin, whom the Council selected this year for this award, in consideration of the very valuable work that he has done for the Association, more especially in connexion with comets and minor planets, on which he is a recognized authority.

Easton Park Nature Sanctuary

EASTON PARK, Dunmow, Essex, which Frances, Countess of Warwick, has recently willed under terms to the Essex County Council to assure its future as a Nature reserve, covers a thousand acres of mixed wood and parkland, and has long been preserved as a wild-life sanctuary, with no shooting and only the rabbits killed. Although a little short of water except for the dewponds, the estate is rich in wild-life: there are considerable numbers of jackdaws, green and spotted woodpeckers, goldfinches and long-tailed tits; goldcrests, hawfinches, kestrels, the three common owls, nuthatches and many jays nest in the woods. In a recent autumn study of the bird sanctuaries there, by invitation of Lady Warwick, Mr. Eric Hardy noted fifty species of bird, including a roosting flock of 195 jackdaws. There are a few red squirrels in the park, but no grey squirrels and no nesting carrion-crows. Wild pheasants and partridge are numerous, and there are two large duck ponds where Lady Warwick intends to introduce ornamental waterfowl. A large four-acre wood around Stone Hall on the south side of the estate is permanently fenced and padlocked and kept as a specially secluded sanctuary for woodland nesters.

IN the grounds of Easton Lodge, Lady Warwick has had erected a number of large aviaries, and converted old conservatories to heated aviaries, totalling eight aviaries in all, the largest, as high as the big aviary at the London Zoo, enclosing a full-grown yew tree. The collection comprises some 17 species and about four hundred specimens, chiefly of foreign finches, and is also used as a 'flying school' for injured or rescued British birds before their release. The aviaries are in the charge of Mr. Gilbert, formerly a keeper of aviaries under Mr. D. Seth-Smith at the London Zoo. The park also contains large herds of red and fallow deer, a herd of Highland cattle, some 700 Shetland sheep, including four-horned rams, a number of Shetland ponies, and some very outstanding trees, including some of the country's best specimens of cedar, wych-elm, oak, maiden-hair, palm and *Ailanthus* or tree of heaven.

Electron Diffraction and Surface Structure

THE thirty-ninth Bedson Lecture was delivered on October 25 in King's College, Newcastle-on-Tyne, by Prof. G. I. Finch, on "Electron Diffraction and Surface Structure". Prof. Finch stated that patterns are obtained on a photographic plate placed in the path of an electron stream which has been allowed to graze the surface of a solid body, and from these diffraction patterns an accurate indication of the surface structure is obtained. The diffraction patterns tend more and more towards well-defined rings with decreasing crystal size and more random orientation, until eventually an effect similar to the Debye-Scherrer pattern is obtained. Experiments with thin films of nickel deposited on a copper surface show that the nickel crystals follow, up to a certain thickness, the orientation and size of the original copper crystals. As the thickness of the nickel film increases to about 30,000 Å., the crystals orient themselves in directions independent of the original copper crystals, although ordinary microscopic examination indicates a continuance of the original orientation. Electron diffraction experiments have also been used for determining the chemical composition of thin surface films, where ordinary chemical analysis has failed; for example, the composition of the blue film on tempered steel razor-blades was successfully determined in this manner. Sir George Beilby's theory of surface liquefaction of solids during polishing has received experimental proof from electron diffraction experiments on polished surfaces, and extremely important work is being carried out in this field in connexion with the 'running-in' of machinery.

Pottery in the Palaeolithic Period

FURTHER evidence on the disputed question of the occurrence of pottery in the later phases of the palaeolithic period was brought forward by Mr. J. P. T. Burchell at a meeting of the Society of Antiquaries held on October 28. Pottery has now been found by him on several sites in the Thames Valley in circumstances which, he maintains, warrant a dating in Upper Palaeolithic times. At a site in the Bean Valley, Kent, which he has excavated recently, pottery occurs between the fourth and the fifth of a series of seven separate deposits of windborne loams. Of these deposits the lowest and oldest is linked with the glacial deposit on which it lies. The first four deposits in the series contain no sign of man, but with the pottery between the fourth and fifth deposits were bones and implements. It has been suggested that the pottery belongs to the bronze age, but Mr. Burchell maintains that the absence of any evidence of a mesolithic culture in the lower beds precludes that view. He relies further on the evidence of the occurrence of the extinct shell *Helicella striata* in beds 2-4. This shell has not been recognized as occurring after the Upper Palaeolithic period. Collateral evidence which possibly may appear more convincing was obtained at Springhead, in the Ebbsfleet Valley, Kent. Here implements similar to those found in the Bean Valley, as well as

those found at Ipswich, with the pottery for which Mr. Reid Moir claims a palæolithic age, were found in an unworn condition in a gravel bed underlying alluvium and peat and resting on a glacial bed. On top of the gravel occurred a large number of scrapers of a type not hitherto recognized and showing marked eolithic characters. These were striated, presumably by floating ice or the movements of semi-frozen material, indicating that the implements, and therefore, presumably, the pottery, dated from before the last glacial manifestation; in other words, that both pottery and implements belonged to Upper Palæolithic times.

Meteorite Craters

THE crater-lake of Kaalijärv, one of the group of craters on the Island of Oesel off the coast of Estonia, has been described on several occasions since 1827, and many suggestions have been made as to its mode of origin. In 1927 and 1929 Mr. I. Reinvald, Inspector of Mines in Estonia, made a detailed survey of the craters with borings and trenches, and he was himself convinced of their meteoritic origin, although he was then unable to find any traces of meteorites at the locality. With remarkable persistence he has again returned to the work of excavation, and in July last he was rewarded by finding in the smaller craters, Nos. 2 and 5, thirty small rusted fragments of nickel-iron, which on a polished and etched surface show a characteristic though rather unusual type of structure. These remnants of the Kaalijärv meteorite finally settle the question of the meteoritic origin of these craters.

ANOTHER meteorite crater has been discovered by Dr. C. T. Madigan, lecturer in geology at the University of Adelaide, during his recent expedition in Central Australia. This was found on the Box Hole station by Plenty River, which is about 200 miles north-east of the famous Henbury craters. It has the form of a shallow basin measuring 200 yards across the rim. During the brief visit no meteoric iron was found on the spot. Another noteworthy discovery made by Dr. Madigan during this expedition is a large meteorite of the rarer siderolite (stony-iron) type, which was seen on the Huckitta station near the Hart Range, about fifty miles from the crater and with no relation to it. It measures 4 ft. 5 in. long and 20 in. high, and is estimated to weigh 2-3 tons. This is considerably larger than any stony-iron meteorite previously recorded, including the original pallasite (Pallas iron) of about 700 kgm. found in 1749 in the Krasnoyarsk district in Siberia.

Distribution of Raw Materials

AN important aspect of the problem of access to raw materials is the consideration of their position with regard to export. This, among other bearings of the question, is discussed by Prof. I. Högbom, in the report of the League of Nations Committee for the Study of the Problem of Raw Materials (Geneva: League of Nations. London: G. Allen and Unwin, Ltd., 1937. 2s.). Prof. Högbom points

out that for certain minerals, the bulk of which is great in comparison to their value, anything more than a relatively short distance from the sea is an almost insuperable bar to exploitation. The same is true of the cheaper and bulkier vegetable products. Thus for many forms of raw material the potential production of the great colonial areas of the interior of Africa and of certain sovereign States is not commercially accessible. Transport cost and not occurrence is the decisive factor in availability. Thus coal and iron ore, if mining for local ore is left out of account, can be economically produced only in Europe, North America, certain parts of the Far East and elsewhere only in a coastal strip some sixty miles in width. The same applies to phosphates. Mineral oil is profitably exportable within about a hundred and fifty miles from the coast. More valuable ores such as tin, copper, manganese and chromium ores can be mined over a much wider area. Prof. Högbom has illustrated these conclusions in a map incorporated in the report.

The Empire's Mineral Wealth

THE leading article in the September issue of *Sands, Clays and Minerals* develops the theory that the Empire can be made in Dr. Johnson's words "rich beyond the dreams of avarice" by economic development of known mineral resources and by systematic exploration of every country within the Empire for hitherto undiscovered deposits. It is no longer practicable to await accidental discoveries of valuable mineral resources: they must be looked for scientifically. Admittedly an exhaustive Imperial mineral survey is a Herculean task, but certain suggestions are made which should go far towards this ultimate aim. It is too great a task for any private concern or individual, or indeed for any Government. It must be undertaken corporately by geologists, metallurgists, economists, Government officials, and others equipped for different phases of the investigation, all of whom must take a share of executive authority. Aerial survey is the means by which information can be obtained on the resources of every country, but this should be conducted on a more scientific basis than hitherto. Present-day mining and metallurgical technique should at the same time be scrutinized and improved wherever possible on the advice of experts. Moreover, ancillary investigations of transport systems, market conditions, currency, tariffs, banking and finance in general, should be undertaken in order to provide a central body with all the information necessary to co-ordinate survey results. Finally, the technical education of the coming generation of geologists, chemists, mineralogists and industrialists, and of the mature worker in these fields should be broadened to give an imperial view-point of mineral resources rather than a restricted outlook on one part only.

British Museum (Bloomsbury): Recent Acquisitions

RECENT accessions to the collections of the British Museum (Bloomsbury) reported at the October meeting of the Trustees include a number of ethnographical

and archaeological objects of exceptional interest. Among these is a war-drum presented by H.M. the King, which was captured from the Khalifa at Khartum in 1898 and given to Queen Victoria by Lord Kitchener. It is of the split-gong type, is made of wood, and is some seven feet long. It is shaped like an animal with a horned head at one end, and is carved with geometrical ornament in relief on the sides. A ceremonial staff from Ashanti, formerly the property of Nana Kobina Amponsah II, Ohene of Busumtwi Stool, has a gold top surmounted by a bird pecking two skulls. Sir Aurel Stein has now decided that the objects allotted to him by the Persian Government from the finds of his journeys of archaeological exploration in Iran should be sent to the British Museum, and the pottery and sherds from his third journey in 1934, on which he traversed the modern province of Fars in south-west Persia, have now been received. They date from well before 3000 B.C. and are of importance as showing affinities with such early sites as Susa and El Obeid in Irak.

THE Department of Oriental Antiquities has received an accession of exceptional importance in the form of five sculptured stone heads from the Buddhist cave temples of T'ien Lung Shan, near Taiyuanfu in Shansi, dating from the sixth to the tenth centuries A.D. They represent a highly developed phase of Chinese religious sculpture, of which very few examples are to be found in British collections. They were given through the British Ambassador in Tokyo by Mr. Kachiro Nezu as a token of friendship to the British nation. Among the British antiquities is a large Roman pottery basin, about seventeen inches in diameter, with figures of horsemen and floral design, which appear upside down. It was found by Colonel and Mrs. A. Ogilvie, by whom it is presented, inside a larger vessel in a kiln at Linwood in the New Forest. It dates from the third century A.D.

Fruit-Cooling Plant at Cape Town

IN *Electrical Industries* of August 11 a description is given of the largest pre-cooling plant in the world, dealing with the fruit exported from Cape Town docks. This installation, which was completed twelve years ago, has made it easy to ensure the low-temperature preservation of fruit as soon as possible after picking. It ensures also that the temperature of the fruit when loaded is comparable with that maintained in the ship's storage chambers on the voyage. Thanks to the Government policy of insisting on high standards and of providing research and educational facilities for fruit growers, the plant is now working at its full capacity and more accommodation is urgently needed. To meet this need, large pre-cooling chambers were projected, and when the entire scheme is completed next year they will have a capacity of 6,000 (shipping) tons. When the fruit trains reach the store from the country, they are shunted into the 'air-lock', a large asphalt-floored shed 74 feet wide by 900 feet long. The fruit is examined and tested there by the Government in-

spectors, and that which does not reach export standard is rejected. The standard fruit is then transferred by battery vehicles to the ship's side and by crane to the hold. The ammonia method being economically impracticable, the underground storage chambers are cooled by brine circulated through coils. At a considerably lower level is the large engine room containing electric transformers and ammonia compressors. An automatic recorder keeps a visible record of the temperature in every cooling chamber taken every eight minutes. The engine room is provided with an emergency lighting battery plant.

New "North-West Passage"

A BULLETIN from the office of the High Commissioner for Canada announces the receipt of a radio-telegram from the S.S. *Nascopic*, a vessel now under charter to the Canadian Government for the 1937 Arctic Expedition, in which it is stated that the vessel has effected the first crossing of Bellot Strait, forming a second North-West Passage across the Canadian Arctic. The strait separates Somerset Island from the Boothia Peninsula, the northern tip of Canadian mainland. The original "North-West Passage", the discovery of which was for many years the dream of Arctic navigators, as a short route from Europe to Asia, runs farther north than the Bellot route. So early as 1585, John Davis set sail to locate this passage, but it was not until 1903-7 that Captain Roald Amundsen made the voyage along Lancaster Sound, Barrow Strait and Peel Sound which defined the route. The Bellot route, a shorter and possibly better passage, has engaged the attention of Arctic explorers since 1858, when Captain Thomas McClintock, searching for the lost Franklin expedition, endeavoured to make his way through. The attempt, unfortunately, was futile, and other later attempts were equally unsuccessful. The Strait was discovered by Captain W. Kennedy in 1852, when he crossed it by dog-team. The appearance of the waterway is that of a Greenland fjord. It is about twenty miles long and barely a mile wide at its narrowest part. The shores are of granite formation of bold and lofty elevation, with a fair sprinkling of Arctic vegetation. Some of the hill ranges attain heights of 1,500-1,600 feet.

Symbols for Thermodynamical Quantities

THE report of a joint committee of the Chemical Society, Faraday Society and Physical Society on symbols for thermodynamical and physico-chemical quantities and conventions relating to their use has been published. It contains symbols for use in thermodynamics and physical chemistry, with explanatory matter. The objects of the joint committee, it is stated, were to correlate the views of chemists and physicists with regard to the use of symbols for thermodynamic quantities and to deal similarly with symbols for other quantities which are of interest to both chemists and physicists. The committee was very representative, and the report, which is a document of sixteen pages, is of considerable interest. The symbols and conventions of the report have

been adopted as recommended practice by the three societies responsible for it and by *British Chemical Abstracts*. Copies of the report may be obtained by non-members at 6d. per copy or 7s. 6d. per 25 copies, post paid, from the Assistant Secretary, Chemical Society, Burlington House, Piccadilly, London, W.1.

Biological Station in Memory of Pavlov

THE biological station being built at Pavlovo (formerly Koltushi) in memory of the late Prof. I. P. Pavlov is almost completed (Soviet Union Year Book Press Service). The department of evolutionary physiology of the Leningrad Branch of the All-Union Institute of Experimental Medicine is being transferred to Pavlovo, where it will be housed in a newly built laboratory, equipped with the most up-to-date appliances for research, and under the directorship of L. A. Orbelli. The reconstruction of Pavlov's own laboratory is now finished, as are also the new kennels and stables and administrative offices.

Richard Watson (1737-1816)

IN an article on the bicentenary of Richard Watson, professor of chemistry at Cambridge and afterwards Bishop of Llandaff, Prof. J. R. Partington (*Chemistry and Industry*, 56, 819; 1937) directs attention to his important experimental work, particularly on the freezing points of solutions of salts, and to the valuable information on contemporary chemical industries contained in Watson's "Chemical Essays". He gives reasons for concluding that some of the unfavourable criticisms of Watson are unjustified. Although Watson was ignorant of chemistry on his appointment to the professorship, he quickly made himself proficient in the subject and carried out original work of considerable merit, whilst his knowledge of pure and applied chemistry was certainly very extensive. Mr. J. P. de Castro (*ibid.*, p. 846) also directs attention to a portrait of Watson apparently engaged in lecturing on chemistry.

Science, Invention and Society

IN a paper entitled "Science, Invention and Society" at the second Congress on Industrial Physics, Pittsburgh, U.S.A., on May 22 (*J. Applied Physics*, 8, 449; 1937), W. Kaempffert, reviewing some of the technical aspects of society as well as the economic aspects of mass production, stresses the need for government to rely not on politicians but on experts. More organization and control are required. Social invention must become as systematic and as well organized as mechanical invention and scientific discovery if it is to keep pace with the laboratory. We can no longer make the utmost use of scientific and mechanical innovations without social adjustments and social invention. We do not yet know what form of government will be evolved to meet the social needs which have come with science and the machine. At present the tendency appears to be towards a collectivism in which private profit will be severely limited or abolished entirely. This in itself demands more expert control, and whatever form future democratic government may take, it

must be a government by technicians or experts. If democracy itself is to survive the increasing strain to which machine methods and scientific progress subject it, its own character must inevitably be immensely changed from that of eighteenth century egalitarianism.

Eighth International Conference of Genetics

WE are informed by Prof. O. L. Mohr, of Oslo, chairman of the International Committee of Genetics Congresses, that the question as to the place for the next International Congress of Genetics has now been considered and voted upon by the International Committee, which has by a large majority resolved to invite the British geneticists to arrange the next congress in Great Britain in 1939. The committee of the British Genetical Society has passed a resolution welcoming the invitation. British geneticists will shortly appoint an organization committee, after which further information concerning the date and place of the congress will be published.

Announcements

IT will be remembered that the late Lord Rutherford had consented to preside over the jubilee meeting of the Indian Science Congress Association to be held in Calcutta next January, which will be attended by a representative British scientific delegation organized by the British Association (see *NATURE*, October 9, p. 609). We are glad to announce that Sir James Jeans has consented to fill the vacancy caused by the lamented death of Lord Rutherford.

THE Society of Glass Technology will hold its twenty-first anniversary meeting on November 9-10, under the presidency of Prof. W. E. S. Turner, at Sheffield, where the inaugural meeting was held in 1916. On November 9, the Society will attend the laying of the foundation block for the new building at Elmfield for the University Department of Glass Technology, towards which the Society has already raised more than £1,500. The Wood Memorial Library will also be opened at Elmfield by Sir Frank Heath on the same day.

DR. H. LOWERY, principal of the North-Western Polytechnic, London, and honorary secretary of the London and Home Counties Branch of the Institute of Physics, has been appointed principal of the new South-West Essex Technical College at Walthamstow as from April 1938.

WE have received from British Drug Houses, Ltd., a priced catalogue of B.D.H. laboratory chemicals. This is a volume of more than two hundred pages, with thumb indexes, and includes indicators, reagents, microscopical stains, minerals and laboratory sundries. It is very gratifying to note what a wide range of chemicals of high quality of British manufacture are now available. The items include both inorganic and organic chemicals, and the prices are quoted for quantities based on the metric system. The address of the firm is Graham Street, City Road, London, N.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 811.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Development of the Spark Discharge

SOME time ago, one of us¹ photographed the long electric spark with a rotating camera and showed that a preliminary discharge occurred prior to the

the former experiments under a variety of physical conditions and have now shown that the pre-discharge traverses the whole of the inter-electrode gap, and only after it reaches the opposite electrode

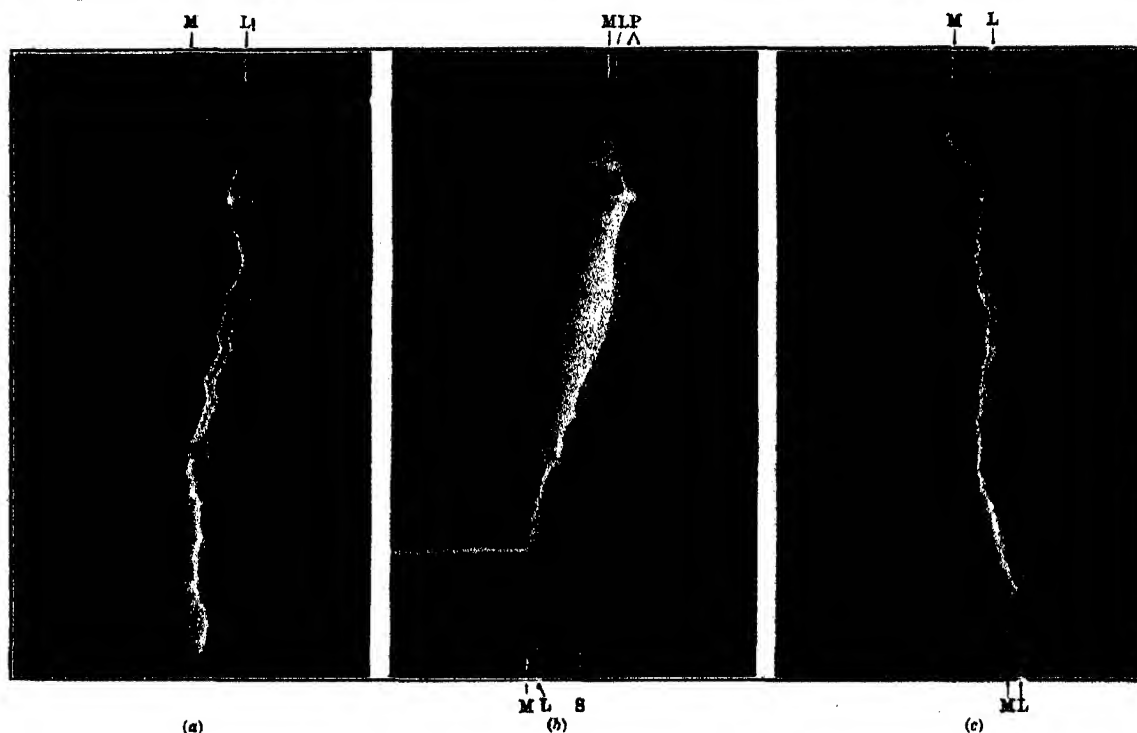


Fig. 1.

- (a) LEADER (L) AND MAIN (M) STROKE FROM POSITIVE HIGH-VOLTAGE POINT TO EARTHED PLANE.
 (b) LEADERS (L) AND MAIN (M) STROKE FROM NEGATIVE HIGH-VOLTAGE POINT AND FROM EARTHED PLANE.
 P = TWO PREDISCHARGES AT THE CATHODE. S = INDEPENDENT STREAMER DISCHARGE RISING FROM THE PLANE ANODE.
 (c) LEADERS (L) AND MAIN (M) STROKE FROM POSITIVE HIGH-VOLTAGE POINT AND FROM POINTED PROJECTION ON THE EARTHED PLANE.

main spark, just as in the case of the lightning discharge studied by Prof. B. F. J. Schonland and others. The original photographs of the spark between a pointed high-voltage electrode and a plane earthed electrode showed the course of this 'leader' discharge for about 20 per cent of the inter-electrode spacing the luminosity diminishing with increasing distance from the high-voltage electrode. The time interval between the leader and the main stroke corresponded to the time-to-sparkover as recorded on the oscillograph. Leader strokes preceded positive and negative discharges.

We have recently had an opportunity of extending

does the main spark develop. Thus the pre-discharge is a 'leader-stroke' exactly analogous to the leader-stroke of the lightning flash. Fig. 1c shows such a discharge at 600 kv. between a positive point electrode and an earthed plane; the time-interval between the leader and the return flash is 72 micro-seconds. The main stroke develops at a much higher speed than the leader stroke, so that it is possible to quote the average speed of development of the leader with fair accuracy. For a succession of sparks at this voltage its average speed was 1.9×10^8 cm./sec., but we have found that the speed increases as the leader approaches the opposite electrode.

When the high-voltage point is of negative polarity, the spark presents a rather different appearance. In addition to the leader from the high-voltage point, a leader also precedes the main stroke at the earthed plane, and the two leaders develop towards one another, meeting at mid-gap as in Fig. 1 *b* for a 900 kv. spark. This type of leader has not hitherto been observed in the lightning flash, but its appearance is not surprising, as upward directed streamers are often observed developing from a plane electrode in a negative field. The time interval between the negative leader and the main stroke at the cathode is generally greater than between the positive leader and the main stroke at the anode. The velocity of the negative leader in Fig. 1 *b* is 2.4×10^6 cm./sec. and that of the positive leader is 4.4×10^6 cm./sec. Generally one or more discharges develop from the cathode but fail to bridge the inter-electrode gap; however, they ionize a path which the final leader stroke takes. Two such pre-discharges can be observed in Fig. 1 *b* at the cathode.

If a pointed electrode projects out of the earthed plane for a fraction of the inter-electrode gap, a leader stroke develops from this point upwards irrespective of the applied polarity. Such a double leader is shown in Fig. 1 *c* for a positive high-voltage point electrode; the point at the cathode projects 4 in., and the gap is 40 in. In Figs. 1 *b* and *c* it will be seen that the leader stroke developing upwards from the earthed electrode is also branched upwards, and we have now definitely established that the direction of branching indicates the direction of propagation of the leader stroke, since the leader stroke is initially responsible for all branching. These results should suggest therefore that Boys camera photographs of upward branched lightning strokes will show upward propagation of the leader stroke.

Experiments at pressures down to one tenth atmospheric pressure substantiate the above and indicate that the time intervals between the leader and the main stroke increase rapidly with diminishing pressure.

We desire to thank Dr. A. P. M. Fleming for permission to publish this note.

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Sept. 29.

¹Allibone and Schonland, *NATURE*, 134, 736 (1934).

Splitting of the Hæmocyanin Molecule by Ultra-sonic Waves

EMULSIONS and colloidal solutions may be produced by means of ultra-sonic waves^{1,2}. Compounds such as starch and gelatine are depolymerized^{3,4}. It seemed, therefore, of interest to study the action of sonic waves on high-molecular proteins such as the hæmocyanins, the molecules of which are of 'colloidal' size. In the investigation I used hæmocyanin from *Helix pomatia*, which has a molecular weight of 6,740,000, a sedimentation constant of 99×10^{-13} and which, upon change of the pH, gives three dissociation fragments with the sedimentation constants 52, 16 and 12×10^{-13} respectively (correspond-

ing to $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{6}$ molecules). These fragments may reversibly recombine to form the original molecule^{5,6,7}.

Dilute solutions of the hæmocyanin (0.1–0.4 per cent) were treated by sonic waves with a frequency of 250,000 per sec. and the effects were studied by means of the ultra-centrifuge. The solution of the protein was centrifuged before and after the treatment, and it was found that the sound-waves had partly split the hæmocyanin. The fragments obtained were uniform (monodispers) and were equal to $\frac{1}{2}$ and $\frac{1}{3}$ of the molecule, that is, in size corresponding to the fragments which are obtained by changing the pH. A solution of pH 6.2 containing only the original molecule gave after treatment 20 per cent of half molecules. A solution of pH 7.2 containing 64 per cent of the original molecule and 36 per cent half molecules gave 35 per cent original molecules, 44 per cent half molecules and 21 per cent eighth molecules. Usually the one-eighth molecule is obtained only when the pH reaches 8.0. The total concentration of the different kinds of soluble molecules was in most cases the same in the treated and in the non-treated solutions. In a few cases, however, when the initial solution was not clear due to precipitated hæmocyanin, a larger total concentration of soluble molecules occurs in the treated solution. In these cases the sound-waves may have brought a part of the precipitate into solution.

The action of the sound-waves was accompanied by a rise in temperature to about 40° C. Heat treatment alone at 50° C. of a solution with whole and half molecules did not, however, change the relative percentage of the two molecules. By heating to 60° C. non-uniform compounds of association were obtained.

The fragments, $\frac{1}{2}$ and $\frac{1}{3}$ molecules, formed by action of the ultra-sonic waves, do not, upon a change of pH from 7.2 to 6.2, show any tendency to recombine to the original molecule. Apparently there is a difference between the hæmocyanin molecule in the native state and that treated with sonic waves.

During the sonic treatment amino-acids or similar low-molecular compounds may have been split from the molecule. Since in some cases small amounts of such foreign substances are known to cause dissociation of proteins^{8,9}, this might be a possible explanation of the splitting of the hæmocyanin molecule to halves and eighths. Therefore the treated solution was dialysed before centrifuging, but the same results were obtained.

The electrophoretic properties were not changed by the treatment.

Details concerning the apparatus and results will be published elsewhere.

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Sept. 25.

¹Wood, R. W., and Loomis, A. L., *Phil. Mag.*, (7), 4, 417 (1927).

²Freundlich, H., Söller, K., and Rogowski, F., *Kolloidchem. Beih.*, 27, 223 (1933).

³Szent-Györgyi, A., *NATURE*, 131, 278 (1933).

⁴Szalay, A., *Z. phys. Chem.*, A, 194, 234 (1933).

⁵Svedberg, T., *NATURE*, 130, 1051 (1937).

⁶Svedberg, T., and Hedenius, A., *Biol. Bull.*, 66, 191 (1934).

⁷Eriksson-Quensel, L.-B., and Svedberg, T., *Biol. Bull.*, 71, 498 (1936).

⁸Lundgren, H. P., unpublished.

Action of Iodoacetate on Dehydrogenases and Alcoholic Fermentation

It is well known that iodoacetate produces a complete inhibition of alcoholic fermentation in yeast and of lactic acid formation in muscle even in very dilute concentrations ($M/3000$ or less). Up to the present, however, its mode of action and the precise point at which it attacks the catalytic systems are unknown, for none of the enzymes which has been tested is inhibited by such low concentrations. In high concentrations ($>M/20$) iodoacetate is a general enzyme poison and inhibits almost every enzyme tested. In moderate concentrations ($M/100$), it has no action on most enzymes and has hitherto only been shown to inhibit aldehyde mutase¹ and glyoxalase (the latter by an action not on the enzyme but on its coenzyme glutathione). These systems, however, are not inhibited by $M/3000$ iodoacetate, so that we must seek elsewhere for an explanation of its action on fermentation and glycolysis.

A systematic study of the action of iodoacetate on the dehydrogenases has not previously been made, but the results of such a survey are summarized in the accompanying table. It will be seen that while several of the dehydrogenases show a partial inhibition by $M/100$ iodoacetate, they are, with one exception, unaffected by a concentration of $M/3000$. The alcohol dehydrogenase stands out in a remarkable way as being the only dehydrogenase, and indeed the only enzyme, to be inhibited by this concentration. The inhibition becomes complete on slightly longer incubation.

Dehydrogenase	Source	% Inhibition after 10 min. incubation with iodoacetate	
		$M/3000$	$M/100$
Lactic	Yeast	0	7
Alcohol	"	92	100
Triosephosphate (Hexosediphosphate)	"	5	95
α -Glycerophosphate	"	3	60
Lactic	Muscle	0	62
α -Glycerophosphate	"	0	42
Succinic	"	0	11
Fumaric	"	0	3
Malic	"	0	0
Xanthine	Milk	0	0
Aldehyde	"	0	5
Aldehyde mutase	Liver	0	95

The enzymes were prepared and tested with methylene blue at 38° and pH 7.4 essentially as described by Leloir and Dixon². Before testing, the enzymes were incubated at 38° for 10 minutes with the above concentrations of iodoacetate in the absence of substrates and co-enzymes. Owing to dilution on adding these, the iodoacetate concentrations during the actual tests were reduced to one half. The controls without iodoacetate were always incubated similarly before testing.

That the iodoacetate acts on the dehydrogenase (that is, Warburg's 'specific protein'; Euler's 'apodehydrogenase') itself, rather than on the coenzyme or on any enzyme-coenzyme complex, is clearly shown by the following experiment, which is made possible by the fact that the inhibition is not instantaneous but is set up by a time-reaction.

Thunberg tubes with hollow stoppers were used, so that either the enzyme or the coenzyme could be exposed to the iodoacetate during the preliminary incubation period. The reagents were distributed as follows:

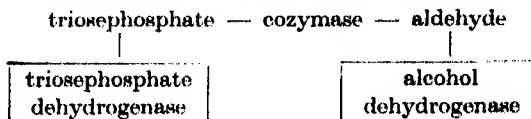
In tube	In stopper
2 c.c. enzyme in phosphate	1 c.c. M alcohol
1 c.c. $M/3000$ methylene blue	0.2 c.c. coenzyme
	1.5 c.c. phosphate, pH 7.4
	(0.3 c.c. $M/50$ iodoacetate)

The tubes were evacuated and incubated for 20 minutes at 38° before mixing.

	Reduction time at 38°
Tube 1 No iodoacetate	3 m. 0 s.
Tube 2 Iodoacetate in tube	∞
Tube 3 Iodoacetate in stopper	3 m. 55 s.
(Controls without coenzyme or alcohol were negative.)	

It will be seen that tubes 2 and 3 contained the same reagents, but these were differently distributed during the initial incubation. When the iodoacetate and enzyme were incubated together, complete inhibition resulted, but incubation of the coenzyme with iodoacetate had little effect. Another tube, as tube 2 but with the alcohol and methylene blue interchanged, gave almost as much inhibition, showing that the enzyme was not appreciably protected by the presence of its substrate.

The specific poisoning of the alcohol dehydrogenase by small concentrations of iodoacetate provides a possible explanation for the inhibition of alcoholic fermentation in yeast. This dehydrogenase (=the 'aldehyde reductase' of Warburg) is a reversible system, catalysing the reduction of aldehyde to alcohol as well as the oxidation of alcohol. According to v. Euler³, it plays an essential part in the main processes of fermentation, namely, the oxido-reduction reaction between triosephosphate and acetaldehyde, which we may represent as follows:



The aldehyde, activated by the alcohol dehydrogenase, is reduced to alcohol by activated triosephosphate, coenzyme acting as a hydrogen carrier. If then the alcohol dehydrogenase is inhibited, this can no longer occur. Thus at any rate one point of attack of iodoacetate on the fermentation system has been found.

While this effect may be adequate to account for the inhibition of alcoholic fermentation, it is still possible that the iodoacetate acts also at some other point in the yeast system. In the glycolytic system of muscle, the lactic dehydrogenase, which occupies a position corresponding to the alcohol dehydrogenase in yeast, is completely resistant to dilute iodoacetate. These results, therefore, cannot account for the inhibition in muscle; the iodoacetate acts elsewhere in the muscle system and hence possibly in the yeast system also, in addition to the action described above. It is believed by many that iodoacetate acts on the initial stages of glucose fermentation by inhibiting the phosphorylating mechanism, for in yeast (unlike muscle) no glucose disappears and no intermediate products are found in presence of iodoacetate. But this is to be expected if we assume that the energy required for the phosphorylation is derived from the oxido-reduction, for inhibition of the latter process will obviously produce an indirect inhibition of the phosphorylation also.

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Oct. 5.

¹ Dixon and Lutwak-Mann, *Biochem. J.*, **31**, 1847 (1937).

² Leloir and Dixon, *Enzymologia*, **2**, 81 (1937).

³ v. Euler, Adler and Hellström, *Hoppe-Seyl. Z.*, **301**, 299 (1936).

Reaction between Proteins and Metaphosphoric Acid

In connexion with a publication by R. K. Schofield¹, we have prepared and analysed precipitates obtained from pure proteins with metaphosphoric acid.

1 c.c. of either egg albumen or clupein sulphate solution was mixed with 0.5 c.c. or 1 c.c. respectively 0.1 N metaphosphoric acid, centrifuged and washed with distilled water. When the washings were found free from proteins and metaphosphoric acid the precipitates were dissolved in concentrated sulphuric acid and analysed. (Content of precipitates of P and N in the table are mgm.)

Protein	Solution					Precipitate		
	Total N	Amino N		Total N/Amino N		Total N	Bound P	Ratio of total N to amino N calc. from bound P
		van Slyke	titr.*	van Slyke	titr.*			
Ovalbumin 1.8 per cent	3.1	0.22	0.25	14.0	12.5	2.99	0.49	13.2
						2.90	0.48	13.6
						2.90	0.46	13.9
						2.89	0.46	13.9
Clupein 1 per cent	2.18	Pos. charged amino N calculated		Ratio of total N to pos. charged amino N		2.18 2.16 2.14 2.15	1.06 1.05 1.02 1.02	4.55 4.55 4.70 4.70
		(3)	(4)	(3)	(4)			
		0.475*	0.475*	4.6*	4.55*			
		0.499	0.505	4.4	4.3			

* Calculated for arginine.

The table shows a good agreement between the amount of phosphorus bound and the number of the free amino groups in the egg albumen and the number of positively charged amino groups (guanido groups of the arginin radicals) in the clupein.

We intend to publish a full report of this work later, but we mention these results because according to some workers² the products obtained with precipitants of this kind should have no fixed composition, whereas other investigators³ suppose them to be true salts.

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¹ Schofield, R. K., *Trans. Farad. Soc.*, (1) **81**, 104 (1935).

² Linderström-Lang, K., *Compt. rend. Lab. Carlsberg*, **17**, 4 (1935).

³ Waldschmidt-Leitz, E., Ziegler, F., Schäffner, A., and Well, L., *Hoppe Seyler's Z.*, **197**, 219 (1931).

⁴ Linderström-Lang, K., and Rasmussen, E., *Compt. rend. Lab. Carlsberg*, **20**, 10 (1935).

⁵ Dullere, W. L., and Mine, R., *Compt. rend. Soc. Biol.*, **25**, 1040 (1927).

⁶ Meyer, K., Palmer, W. Y., and Smyth, E. M., *J. Biol. Chem.*, **119**, 501 (1937).

Action of Auxin on Protoplasmic Streaming

STUDIES on the mechanism by which auxin exerts its growth-promoting action on plant cells have indicated that, although ultimately detectable on the cell-wall, the effect is exerted in the first instance on the protoplasm. The results of Bonner¹ established a close connexion between growth and respiration, although pure auxin was not found; either by him or by van Hulst², to increase respiration appreciably.

In an attempt to analyse the initial stages of auxin action, we have studied protoplasmic streaming in the epidermal cells of *Avena coleoptiles*. The streaming rate, as was shown by Bottelier³, is dependent upon oxygen supply. Low concentrations of indole-3-acetic acid, from 0.003 to 0.02 mgm. per litre, accelerate the streaming. Coumaryl-acetic and allocinnamic acids, which also possess growth-promoting activity, have a similar effect. The acceleration is ordinarily transient, lasting only about 30 minutes, but if after a lapse of a further 30 minutes auxin is again added, a second acceleration similar

to the first is obtained. When, however, fructose is added with the auxin, the acceleration is maintained for at least two hours. The limiting factor is, therefore, the carbohydrate supply.

The effect of higher concentrations of auxin depends upon the oxygen supply. In 5 cm. coleoptiles, if ample oxygen is available, all auxin concentrations up to 5 mgm. per litre cause about the same acceleration. If oxygen is more nearly limiting, the auxin causes a retardation of streaming. This retardation is removed by oxygen, but is increased

by dinitrophenol. We therefore conclude that auxin accelerates a respiratory process which controls streaming, and of which carbohydrate is the substrate. Auxin must also accelerate another respiratory process which, by consuming the available oxygen, makes the first process oxygen-deficient and hence retards the streaming. Both processes together probably make up only a small part of the total respiration of the coleoptile.

In younger (3 cm.) coleoptiles, the respiration rate is greater and consequently the streaming soon slows down in presence of insufficient oxygen. If auxin, 0.01 mgm. per litre or above, be added, the retardation is more rapid. On the other hand, if histidine, 6×10^{-7} molar, be added, this retardation is delayed. Since histidine alone does not accelerate streaming, it follows that histidine decreases the consumption of oxygen by those processes which do not control streaming. This may explain the well-known experiments of Fitting on *Vallisneria* leaves, in which the streaming, after stoppage, is retarded by dilute histidine solutions.

The respiration of the coleoptile must therefore be regarded as comprising at least three processes:

(1) A reaction oxidizing sugar, which controls the rate of streaming and of growth; accelerated by auxin, not affected by histidine or dinitrophenol.

(2) A reaction oxidizing sugar, which does not affect the rate of streaming; accelerated by auxin.

(3) Other oxidative reactions, which do not affect streaming or growth; insensitive to auxin, accelerated by dinitrophenol, inhibited by histidine. These reactions account for the larger part of the observed oxygen consumption.

On this view the rates of streaming and of growth are controlled by the same process, and thus the

effect of auxin on streaming is probably one of the first stages of its effect on growth. This agrees with the rapidity of its action, the acceleration of streaming beginning within two minutes of auxin application. Correspondingly, those concentrations of auxin which affect streaming in coleoptiles with ample oxygen supply, show close agreement with the concentrations which affect growth in measurements made over the same short period. Thus the effects of auxin on streaming, and presumably also on growth, arise from the acceleration of a respiratory reaction.

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Sept. 30.

¹ Bonner, J., *J. Gen. Physiol.*, **20**, 1 (1936).

² van Hulsen, C. J., *Dissertation*, Utrecht (1936).

³ Botteller, H. P., *Rec. trav. bot. néerl.*, **32**, 287 (1935).

Photoperiodic After-Effect

SEVERAL workers, notably Eghis, Rasumov and Dolgušin, claim to have demonstrated a photoperiodic after-effect with short-day plants, that is, an acceleration of flowering in such plants exposed to short days during the early stages of growth and afterwards grown in long days. This work has been done mainly on cereals and fodder plants, and so far as we are aware the existence of such an after-effect has not been demonstrated with any ornamental flowering plants.

Experiments have been in progress for some time in this department with a Mexican short-day plant, *Tithonia speciosa*. During this year the existence of a photoperiodic after-effect has been demonstrated. Seeds were sown in a glasshouse on April 19, and some of the seedlings covered with black shades from 5.0 p.m. to 7.0 a.m. daily (10-hour day), from germination. Sixteen plants received five weeks of short-day treatment and a similar number seven weeks. A further sixteen plants received the normal day length of fourteen to sixteen hours. All plants were planted in the open (in four randomized plots) on June 9. The first flowers of the seven-week treatment plants opened on June 21. The mean number of days from sowing to opening of the first and second flowers respectively for each treatment were as follows:

	Untreated	Five-week treatment	Seven-week treatment
No. of days to first flower	127	80	71
No. of days to second flower	136	97	83

This acceleration in flowering date was accompanied by a change in the entire habit of the plants. The control plants grew to the normal height of more than six feet with a thick, straight, main axis and lateral branches bearing very large leaves, deeply lobed. The plants receiving the longer short-day treatment were, in contrast, much less in height (about 2-2½ feet) freely branched, with in many cases no well-developed main axis and with unlobed leaves about a third of the normal size. The plants of the remaining treatment were intermediate in character.

The early-flowering habit of the treated plants was maintained throughout the season. The total number

of flowers produced by the sixteen plants of each series up to September 21 was as follows:

	Untreated	Five-week treatment	Seven-week treatment
Total no. of flowers (16 plants) ..	231	616	555

Further experiments will be carried out to determine the minimum exposure to short-day necessary to produce an effect, the maximum day-length, relation to temperature, etc.

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Oct. 8.

Flaked Flints from the Bone Beds of Bethlehem

OWING to absence abroad, I have not been able to write sooner on the subject of the very interesting article on "The Bone-Bearing Beds of Bethlehem" in NATURE of September 4.

I visited the Bethlehem site several times while Miss Bate and Miss Gardner were working on it in the spring of 1935, and was able to see the geological conditions described by Miss Gardner so far as they were then exposed. In July of this year I visited the Wellcome Museum with Miss Caton-Thompson in order to examine the flints which are thought to be artefacts, and came to the conclusion that none of them showed any flaking that could not be explained by the action of the mechanical forces to which they had admittedly been subjected. In contrast with the sub-Crag industry, there is an absence of flakes showing anything that could truly be described as a bulb of percussion, and the edge-trimming, which has rightly been compared with that of the Harrisonian eoliths, is of the vertical type well known as an effect of flaking by pressure in the soil.

A few weeks after I had seen the flints, Miss Gardner and I were able, by kind permission of Mr. Starkey, to show the whole collection to the Abbé Breuil, who was passing through London. He examined the flints and studied Miss Gardner's sections at some length, and his final opinion was that none of the specimens showed any flaking that could not be explained by the condition of the deposit in which they were found. He compared the Bethlehem site with that of Saint-Prest, near Chartres, where a hollow in the chalk had been filled up with an *argile à silex* yielding remains of *Elephas meridionalis*. The associated flints, which he said closely resembled those from Bethlehem, had at one time been claimed as artefacts by the Abbé Bourgeois and others, but were now generally admitted to be flaked by mechanical action.

Miss Caton-Thompson has herself stated and discussed so clearly the case for and against the human origin of the Bethlehem flints that further comment is scarcely necessary. I differ from her only in her final conclusion that these specimens are "less easy reasonably to explain as the accidental work of natural forces, than as the deliberate experimental work of man. . . ."

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Oct. 8.

Meteorites: the Number of Pultusk Stones, and the Spelling of "Widmanstätten Figures"

(1) Since writing my first note¹ I have come across a passage in meteorite literature which, I think, definitely establishes the view that the high figure usually quoted for the number of Pultusk stones was based on a reasonable estimate and was not due to a misreading of a Warsaw publication, as suggested by Dr. Stenz.² Daubrée³ mentions this very publication, and refutes energetically the low figures therein given as being "bien loin de la réalité". He knows already (August 1868) of more than 3,000 stones actually found, and emphasizes the exceptionally unfavourable circumstances for their collection. So, evidently, it was not ignorance of the statement made by the Haute École de Varsovie, but opposition to it, based on more extended knowledge which induced French, Austrian and German authorities to adopt the high value for the total number of the stones.

Dr. L. J. Spencer's contribution⁴ to the question contains interesting details about the transfer of Pultusk stones from the Krantz collection to that of the British Museum. He is right in saying that I over-estimated the proportion of small stones originally present in the former. While the expression used by vom Rath is ambiguous, fortunately it happens that in a paper by Buchner⁵ definite figures are given concerning the unsorted material which had been collected for Dr. Krantz. The average weight of Krantz's 2,012 stones was 61.2 gm. His collectors seem to have paid somewhat more attention to the small stones than did those of Daubrée—who had 942 stones of an average weight of 67.5 gm.—but even in Krantz's material the small stones were certainly not represented in the same proportion as in the original shower, because of the difficulty, or impossibility, of finding them. For other reasons (as Dr. Spencer puts it, because "the best museums strive to acquire the best specimens") there is a further shift towards the big stones in most of the museum collections. In the British Museum the average weight of the Pultusk stones is as high as 252 gm.

A characteristic feature of the Pultusk shower was the high proportion of small stones. None were collected of less than 1 gm., but the reports mention black 'dust', and we know that in meteorite showers of this type the stones between 0.1 gm. and 1 gm. may outnumber all those between 1 gm. and 10 kgm. Statements as to the supposed total number of stones should be accompanied by an indication as to the supposed average weight; to speak of 100,000 Pultusk stones may be misleading if the reader, or visitor, visualizes the average composition of certain museum collections. The weight of the total shower was perhaps only a small multiple of the 200 kgm. recovered, while 100,000 stones of the British Museum quality would make a total weight of more than 25,000 kgm.

(2) As to the spelling of "Widmanstätten figures", the issue now simply is whether we want to adopt the form of the name used by other members of the family, or the one chosen by the man himself. Dr. Spencer prefers the former alternative; those who share his opinion should speak of Beckh-Widmanstätten figures, or simply Beckh figures, for Beckh is the real family name. The discoverer of the etching figures, however, had dropped the Beckh entirely, called himself Widmanstätten, and was officially and privately known under this name.

Since Dr. Spencer does not appear to dispute this fact, I do not think it necessary to quote more of the historic material from the Austrian archives than was given in my first note; but I should like here to express my thanks for all the trouble they have taken in making, or answering, inquiries, to Dr. H. A. Beckh-Widmanstetter, and Profs. H. Benndorf, A. Lecher, S. Meyer and P. Puntchart. I am especially indebted to Prof. S. Meyer for collecting and forwarding the material to me.

F. A. PANETH.

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London, S.W.7.
Oct. 9.

¹ NATURE, 140, 504 (1937).

² Stenz, E., NATURE, 140, 113 (1937).

³ Daubrée, A., *Compt. rend.*, 67, 389 (1868).

⁴ Spencer, L. J., NATURE, 140, 589 (1937).

⁵ Buchner, O., *Poggendorff's Annalen*, 136, 589 (1869).

The Sign and Symbol of Heat of Reaction

THE recent report of the Joint Committee of the Chemical, Faraday, and Physical Societies on Symbols for Thermodynamical and Physico-Chemical Quantities may be taken as an occasion for some remarks on the sign and symbol of heat of reaction and allied quantities. As is familiar, the heat of a reaction may be defined as the heat generated or lost by the system, when unit mass of reactants passes into resultants, the unit of mass being the number of grams represented by the sum of the molecular weights multiplied by their respective coefficients on either side of the chemical equation.

Confining ourselves for present purposes to constant pressure conditions, and representing the enthalpy of the system by H , the mass of resultants in the above units by m , the heat of reaction is expressed by $-\partial H/\partial m$. If the process considered is that of solution, the same expression holds, the unit in which m is expressed being either the gram or the mol according to convenience. In contrast to these 'chemical' cases, we have the 'physical' cases of fusion and evaporation. In fusion, the solid is the reactant, the liquid the resultant, but here the heat of fusion is defined as the heat taken up by the system, and is expressed by $+\partial H/\partial m$, a similar expression holding for heat of evaporation.

These facts illustrate a fundamentally different outlook on the part of the physicist and the chemist. Considering the matter thermodynamically, the universe, regarded as an insulated system, is divided into two portions, the 'system considered', and the 'surroundings', which obviously include the observer. All changes of total energy and all reversible changes of available energy in these two portions are equal but of opposite sign. The physicist concentrates his attention on the former, the chemist tends to concentrate his on the latter portion. This has in the past gone beyond the instances considered, and some physical chemists of unassailable position have used ordinary thermodynamical symbols to express the negative values of the quantities usually associated with them.

With the view no doubt of counteracting the confusion thus created, the Bunsen Gesellschaft some years ago recommended that whereas quantities entering a system should be indicated by ordinary symbols, the quantities leaving the system should be indicated by the same symbols with a minus sign or bar drawn through them. I

should have liked to extend this recommendation, and to express the negative values of most thermodynamical functions where suitable by their signs with a bar drawn through them.

This leads us to the recently issued report. Although slightly diffident in view of its general excellence, and the distinguished names attached to it, I am yet impelled to enter a protest against a group of condemnations or bans contained in it on page 6. They are as follow: (1) The ban on the use of bars discussed above. (2) The ban on the use of a single symbol for such familiar concepts as heat of reaction. (3) An implied ban on the employment of simple thermochemical equations as hitherto used. A mode of expressing thermochemical data is given. I am in agreement with this for purposes of tabulation, although a purist might correctly object that the thermodynamical expression adopted for heat of reaction endows it with the dimension of "calorie" instead of "calorie per equational mol". Most readers of the report will, however, infer that the ordinary thermochemical equations of the past, all the symbols of which represent fully defined mathematical quantities, and which can therefore be treated by the ordinary methods of algebra, are banned. (4) The ban on the use of symbols such as U to express changes or differences in the magnitudes represented. When we remember that such symbols are by original definition referred to an arbitrary zero condition, it becomes obvious that by making the 'reactant' state the arbitrary zero, the quantity ΔU becomes equal to U , and an insistence on the use of Δ is unnecessary. Arising out of this ban we have the abbreviations proposed for $X_2 - X_1$, which are as long as the expression abbreviated. I prefer the symbol X_{2-1} , which is clear, and useful in such cases, say, as the summing of potential differences, etc.

HENRY J. S. SAND.

Sir John Cass Technical Institute,
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Oct. 2.

Effect of Viscosity on Ionic Mobilities

IN the course of some measurements of electrolytic conductivity, I have determined the effect of increasing concentrations of phenol upon the equivalent conductance of a very dilute solution of hydrochloric acid in water at 25°. Using the viscosity data of Swearingen¹, m is found to be 1.000 in the equation $\lambda' = \lambda F^m$, where λ' is the measured equivalent conductance, λ the predicted equivalent conductance in the absence of phenol, and F the relative fluidity of the phenol solution. Above 0.30 normal phenol concentration, m becomes increasingly less than 1. Stokes's law would predict $m = 1$. The concentration of hydrochloric acid was 10^{-4} normal.

This type of measurement is of particular interest for the following reason. The deviation of the stoichiometric ionization constant of a weak acid from the Debye-Hückel limiting law: $\log K_T = \log K_S - 1.013\sqrt{C_i}$, where K_S and K_T are the stoichiometric and thermodynamic ionization constants respectively, and C_i the ionic strength, can only be explained by a decrease in the ionic mobilities as the proportion of unionized acid increases. Progressive change in the activity coefficients of the ions and molecules concerned can explain only a small fraction of the deviation. This is clearly shown by the work of MacInnes and Shedlovsky² on acetic acid, and by similar investigations on propionic and

normal butyric acids which I shall publish shortly. Davies³ was the first to point out that if mobilities are corrected for viscosity according to the simple law $\lambda' = \lambda F$, the observed deviations largely disappear. This is an indirect demonstration that viscosity is mainly responsible for what MacInnes and Shedlovsky term the medium effect.

It is not feasible to measure the medium effect directly, but the kind of experiment I have performed for phenol approximates closely to a direct method, since, due to the high mobility of hydrogen ion, the effect on hydrogen and chloride should not differ markedly from that on hydrogen and phenate ions. The ionization of the very weak phenol will be inappreciable in the presence of hydrochloric acid.

Many years ago experiment⁴ showed that for various systems the exponent m differed widely from 1. It is to be wondered whether, if these experiments were to be repeated to-day with all the benefits of modern technique, m would not turn out to be 1, at least at the lower concentrations of the non-electrolyte.

I understand that Dr. Shedlovsky has made a similar investigation of the medium effect in acetic acid. It is hoped that he will be stimulated to publish these experiments, which precede mine by many years.

DONALD BELCHER.

Laboratory of Physical Chemistry,
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Sept. 24.

¹ Swearingen, *J. Phys. Chem.*, **32**, 785 (1928).

² MacInnes and Shedlovsky, *J. Amer. Chem. Soc.*, **54**, 1429 (1932).

³ Davies, *Phil. Mag.*, **4**, 249 (1927), and "The Conductivity of Solutions" (1933), p. 141.

⁴ Green, *J. Chem. Soc.*, **93**, 2023 (1908).

Neutrino Theory of Light in Three Dimensions

THE neutrino theory of light is based on a fundamental hypothesis of Jordan¹, according to which the emission of a photon must be considered either as emission of two 'coherent' (parallel) particles—neutrino and antineutrino—or as a kind of neutrino Raman effect, without change of direction. This hypothesis permitted Jordan to construct, in the one-dimensional case, the Bose amplitudes required for photons, from the neutrino amplitudes which satisfy the Fermi statistics.

When attempting to construct the commutation rules in the three-dimensional case, the main difficulty is to obtain coherent emission of neutrino and antineutrino².

We should like to propose the following three-dimensional generalization of the one-dimensional expression given previously³ for the relation between the amplitude of photon (b) and neutrino or antineutrino respectively (a or c , respectively):

$$b(\mathbf{k}) = \lim_{\epsilon \rightarrow 0} \frac{\epsilon i}{\sqrt{2}} \int d\mathbf{l} \left\{ \frac{a + (1)a(\mathbf{l} + \mathbf{k}) + c(\mathbf{l} + \mathbf{k})c + (1)}{[\sqrt{(\mathbf{k} + \mathbf{l})^2 + k_0^2} - \sqrt{l^2 + k_0^2} - k] \sqrt{[(\mathbf{k} + \mathbf{l})^2 + k_0^2][l^2 + k_0^2]}} \right. \\ \left. - \frac{c(\mathbf{k} - \mathbf{l})a(\mathbf{l})}{[\sqrt{(\mathbf{k} - \mathbf{l})^2 + k_0^2} + \sqrt{l^2 + k_0^2} - k] \sqrt{[(\mathbf{k} - \mathbf{l})^2 + k_0^2][l^2 + k_0^2]}} \right\}$$

where $\epsilon = \mu \sqrt{\frac{c^2}{4\pi h}}$, $k_0 = \frac{\mu c}{h}$, $d\mathbf{l} = dl_1 dl_2 dl_3$

and μ is the mass of neutrino.

With $b^+(\mathbf{k})$ constructed analogously, the required Bose commutation rules are verified immediately for $b(\mathbf{k})$ and $b^+(\mathbf{k})$ if the amplitudes of neutrinos and antineutrinos obey the Fermi statistics, and if all the states above a certain one are unoccupied.

Regarding ϵ as the 'charge' of neutrino, we see that the coherence condition is fulfilled, both 'charge' and mass of the neutrino particles tending to zero, but their relation remaining finite and equal to $\sqrt{\frac{c^2}{4\pi\hbar}}$ (neutrino) and $-\sqrt{\frac{c^2}{4\pi\hbar}}$ (antineutrino).

In the same way, it is possible to take into account the spin of neutrino particles and to obtain a formula⁴ correspondingly generalized.

A. SOKOLOV.

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Tomsk.
Sept. 13.

¹ Jordan, P., *Z. Phys.*, **93**, 464 (1935).

² cf. Jordan, P., and Kronig, R. de L., *Z. Phys.*, **100**, 569 (1936).

³ Sokolow, A., *NATURE*, **139**, 1071 (1937).

⁴ cf. Sokolow, A., "On the Neutrino Theory of Light (three dimensional case)", *Phys. Z. Sowjetunion*, in the press.

Dry Crossing of the Nile

READERS who have followed the correspondence under this head^{1,2} may be interested to learn that the dry crossing, which is situated at a point some

10½ miles downstream of Nimule, is definitely reported by Mr. N. B. Watney, district commissioner, West Nile, to be breaking up³.

My original informant, a native, told me that the crossing formed in 1917, disappeared in 1921, and reformed about 1930—it was certainly well in evidence when I first saw it from the air in the following year. Tradition has it, I learnt, that the dry crossing forms in times of famine and disappears in times of plenty. Recorded famine years are 1898, 1908, 1918-19 and 1928. Thus if these figures are any guide, we should be on the verge of another famine; but administrative precautions in this regard have been well in hand for some time.

Dr. Hurst suggests¹ that he saw the beginnings of this dry crossing in 1924, but it seems that this is not so, for the sudd he refers to was "at a point where the river narrowed suddenly". This it does not do at the dry crossing, and a satisfactory explanation of its repeated formation at that particular spot has yet to be found.

There is a mistake in my original letter¹; "1930" should read "1931".

E. J. WAYLAND.

Geological Survey Office,
Entebbe, Uganda.
Oct. 14.

¹ *NATURE*, **139**, 961 (June 5, 1937).

² *NATURE*, **139**, 994 (June 12, 1937).

³ *Uganda Journal*, **4**, No. 4, 350 (May 1937).

Points from Foregoing Letters

PHOTOGRAPHS taken with a rotating camera by Dr. T. E. Allibone and J. M. Meek show that, in laboratory spark discharges as in lightning, a pre-discharge or 'leader stroke' traverses the whole of the inter-electrode gap before the main discharge occurs. The leader stroke begins from one or both electrodes, travelling at a rate of 20-40 km. per second (faster at reduced pressures). Its direction may be deduced from the branching of the discharge.

The haemocyanin molecule is split into halves and eighths by means of ultra-sonic waves with a frequency of 250,000 per sec. This is inferred by Sven Brohult from sedimentation experiments carried out with the ultra-centrifuge.

Dr. M. Dixon states that iodoacetate, in the concentration required to abolish yeast fermentation, completely inhibits the alcohol dehydrogenase but does not affect any other dehydrogenase tested. This may explain the inhibition of the fermentation. The action is on the enzyme itself and not on the coenzyme or an enzyme-coenzyme complex.

When egg albumen is precipitated with metaphosphoric acid, the ratio of 'bound' phosphorus to nitrogen corresponds to the free amino groups in the albumen, according to Dr. H. Herrmann and G. Perlmann. If clupein solution is used, the ratio corresponds to the number of positively charged amino groups in the clupein molecule.

The growth-promoting hormone, auxin, accelerates the 'streaming' of protoplasm in cells of coleoptiles of young oats, according to Prof. K. V. Thimann and Miss B. M. Sweeney. The effect lasts about half an hour, longer if fructose is added; oxygen supply also is a factor. The authors conclude that the respiration of the young oat coleoptiles comprises at least three processes: one, accelerated by auxin, controls proto-

plasmic streaming and growth; another, also accelerated by auxin, oxidizes sugar and accelerates growth but does not affect streaming; other oxidation reactions which do not affect streaming or growth and are not affected by auxin, are influenced by substances such as histidine and dinitrophenol.

Prof. R. H. Stoughton and D. R. Hole find that, as in the case of cereals and fodder, when the short-day ornamental Mexican plant *Tithonia speciosa* is exposed to short days during the early stage of growth and afterwards to long days, there is a notable acceleration of flowering, and a change in the entire habits of the plant.

Dr. H. J. S. Sand criticizes some of the recommendations made by the Joint Committee of the Chemical, Faraday and Physical Societies on Symbols for Thermodynamical and Physico-Chemical Quantities, namely, its ban on (1) the use of symbols with a bar drawn through them to indicate quantities leaving the system; (2) the use of single symbols for familiar concepts such as the heat of reaction; (3) the employment of simple thermochemical equations as hitherto used; (4) the use of symbols such as U to express changes or differences in the magnitudes represented.

Mr. Donald Belcher finds that, in aqueous solutions of phenol at 25°, the ionic mobilities of hydrochloric acid are proportional to the fluidity to a high degree of accuracy up to 0.3 normal phenol. If this is true for other systems, it is of importance in the interpretation of dissociation constants as determined from conductance measurements.

A. Sokolow proposes a formula for the relation between the field of the photons and neutrino in the three-dimensional case.

Research Items

Boats of Victoria Nyanza

THE question of the origin of the boats of Victoria Nyanza is raised by Mr. G. W. B. Huntingford (*Man*, September) in reference to a suggestion by Mr. J. Hornell that they were due to a possible Indonesian migration to the highlands of Kenya or a long-continued contact with Indonesia along the east coast of Africa. Mr. Hornell pointed out that the peculiar features of these boats, a bifid bow and penetration of the thwarts through the side planks, are features of Javanese and Maduran construction. Mr. Huntingford argues that there are no other traces of Indonesian influence in the Lake region. The Nyanza boats have nothing in common with the coast boats, and there is no sign of Indonesian influence in the Kenya highlands. The enlarged false prow of the Nyanza boats may be an African adaptation without understanding of the branch found on drawings of early Egyptian boats. The Bantu may have taken it over from the Nilotes. Further, both the Egyptian and the Scandinavian types may have originated in Crete. A clay model (Early Minoan I) has something that looks remarkably like a bifid prow. In the same issue of *Man*, Mr. Hornell replies. Against the Egyptian origin, the Egyptians always pegged, and never sewed, the planking of their boats; and the beak of the bifid prow has been much exaggerated in representation. It is not structural but ornamental. Against the argument for an indigenous origin is the lack of skill in boat-construction of the Bantu. As regards the argument against Mr. Hornell's hypothesis of an Indonesian origin, there are cultural features suggesting Indonesian influence in Tanganyika; and there are resemblances to the present-day coast boats in, for example, the sewn planks which characterize Nyanza boats. The absence of outrigger is not vital.

Ethnology of Wallis Island

UVEA (Wallis Island) was visited by Mr. Edwin G. Burrows in 1932 for the purpose of furnishing a report on the ethnological relations of the inhabitants (*Bernice P. Bishop Museum, Bull.*, 145). The nearest islands are Futuna (112 miles), Samoa (186 miles), Fiji (240 miles) and Tonga (332 miles). Uvea has an area of 23 sq. miles. It has been known to Europeans since 1767; and since 1837 there has been a French Catholic Mission in the island, which has strongly affected the culture of the inhabitants, especially in such matters as marriage. The population is increasing. In 1837 it was estimated at not more than three thousand. In 1923 it numbered 4,878. In physical appearance the inhabitants are described as tall, light brown to copper, robust and well proportioned. The cranium is brachycephalic, but occipital flattening is practised. The language is a dialect of Polynesian. Kinship governs social and economic groupings, but politically is important only as limiting succession to titles, the political unit following territorial lines regardless of kin. Yet there are indications that the names of certain villages indicate clusters of kinsfolk. Exogamy has been supplemented by church regulation of marriage.

Brother and sister avoidance formerly was very strict. Polygyny was formerly permitted to certain chiefs. There is no term in the language for the biological family, and the recognized kinship group is the lineage, tracing descent from a common ancestor through the father. The mother-line is recognized secondarily. The nucleus of the kin is the group sharing a homestead. The culture relation is Western Polynesian with elements from Tonga and other islands.

Linkage Relations of Parallel Mutations in *Drosophila*

A COMPARISON of the known genes in *Drosophila melanogaster* and *D. pseudo-obscura* is made by Dr. A. H. Sturtevant and Dr. C. C. Tan (*J. Genetics*, 34, No. 3). Some 25 new mutations of *D. pseudo-obscura* are pointed out as parallel or homologous to those of the other species, in addition to 29 already known; but their arrangement in the chromosomes is different in the two species. *D. pseudo-obscura* has 5 pairs of chromosomes whereas *D. melanogaster* has 4 pairs. The right arm of the X-chromosome in *D. pseudo-obscura* is also known to be homologous with the left arm of chromosome III in *D. melanogaster*. Four or five other species appear to agree in having a two-armed X-chromosome like that of *D. pseudo-obscura*. Chromosomes III and IV of *D. pseudo-obscura* are joined to form II of *D. melanogaster*. The mechanism by which such exchanges of chromosome arms can have happened is discussed. The linkage relationships show that many rearrangements of genes within the arms have taken place, and that since these two species diverged from a common ancestor, at least nineteen such inversions have occurred and become established. By similar methods it is hoped to work out the phylogenetic relationships of other species in the genus, such as *willistoni*, *virilis*, *hydei* and *funeris*.

A New Blow-fly Repellent

FOR the prevention in sheep of myiasis, which exacts a heavy toll in most sheep-rearing countries, many tests have been carried out with a multitude of chemicals, without revealing any thoroughly satisfactory repellent for blow-flies. In Great Britain the most promising recent dip is W. Moore's oil-emulsion dip containing paradichlorobenzene used by the team of workers at Aberdeen under Prof. James Ritchie, but every new suggestion should be thoroughly tested. H. O. Mönning has been experimenting with some oils of common South African plants and shows that steam-distilled oil of *Tagetes minima* has strong repellent properties for blow-flies and that it is suitable for use in a blow-fly dressing. (*Onderstepoort J. Vet. Sci. Anim. Ind.*, 7, 419; 1936). As larvicides, carbon tetrachloride and tetrachlorethylene were found to be effective against the maggots, but the latter had a harmful effect upon wounds. The materials were used as a dressing in an emulsion, the emulsifier which acted most satisfactorily being wool-grease. The author gives particulars for the preparation of a suitable emulsion.

Enzymes of Wood-Rotting Polypores

THE study of fungi which induce the rotting of wood is of great importance, from both practical and theoretical points of view. Polyporaceous fungi often bring about such rotting, and their enzyme equipment has been the subject of study by Dr. S. R. Bose and S. N. Sarkar (*Proc. Roy. Soc.*, B, 123, 193-213; July 1937). Eight species of polypore fungi were examined, and an imposing array of enzymes has been found. Invertase, raffinase, maltase, amylase, emulsin, hemicellulase, cellulase, pectinase and ligninase seem to furnish the possibility of destroying extra-cellular, almost any common carbohydrate. Lipolytic and proteolytic enzymes were present in small quantities, catalase appeared as an intra-cellular enzyme, whilst laccase was found in *Poly-stictus sanguineus*, *Daedalia flavida* and *Trametes lactinea*. Extra-cellular enzymes were more abundant than those inside the cell, and their activity appeared to be greater in the vegetative fungus than in the fruiting organism.

Hybrids of the Rhododendron

A PAPER by Mr. F. C. Puddle (*J. Roy. Hort. Soc.*, 62, 9, 393-398, Sept. 1937) gives some useful information about the possibilities of hybridizing the numerous species of *Rhododendron* now available to horticulturists. The activities of plant collectors have added the beauties of the eastern kinds to the better-known European species. Taxonomists have recognized two sections, the Lepidote and the Elepidote, in the genus *Rhododendron*. It is usually difficult, and frequently impossible, to hybridize between these sections. The Elepidote species of *Rhododendron*, however, interbroed readily with the Luteum series of *Azalea*, although they are plants with more remote taxonomic relationship. Practical considerations for the prosecution of experiments in hybridization are given, and breeders are invited to consult the Stud Book of the Rhododendron Association, which shows the results of more than four hundred crosses the offspring of which have possessed horticultural value.

Antarctic Structure

SOME further evidence in favour of the probable structural relationship of New Zealand to King Edward Land in the Ross Sea is adduced in certain of the bathymetrical work of the Byrd Antarctic Expedition 1933-35. Mr. S. E. Ross, in a paper on the Ross Sea in the *Geographical Review* of October, notes the discovery at the entrance to the Ross Sea, some two hundred miles south of Scott Island, of the Iselin Bank, with a minimum depth of 700 metres and a length of about 200 miles and separated by a deep gully from the continental shelf. Further to the south-east lies the Pennell Bank. The course of the Antartandes may possibly run from New Zealand via Macquarie and Scott Islands and these two banks into King Edward Land. Thus the Pacific Basin appears to be separated from the deep water farther west. King Edward Land turns out to be peninsular in character, extending south-east from Cape Colbeck, and there is considerable evidence that the line of folds is continuous with the Edsel Ford Range farther east. Mr. F. A. Wade, writing on the borderlands of the Ross Sea in the same review, points out the resemblances of this range of folded sedimentaries and intrusive igneous rocks to the

Graham Land region, in spite of the igneous rocks being of the Atlantic rather than the basic Pacific type. It is noteworthy that many indications of former more extensive glaciation were found in this range.

Lhuys's Maps of England and Wales

THE Ortelius atlas published in Antwerp in 1573 included maps of England and Wales and of Wales prepared by Humphrey Lhuys. In "Humphrey Lhuys's Maps of England and of Wales" (National Museum of Wales, 1937. 1s.), Dr. F. J. North discusses these maps, particularly that of Wales, as regards means of preparation and sources of information. The outline of Wales is reasonably good and many rivers and places are shown. Mountains are indicated by conventional hummocks. The scale is about 8 miles to an inch. The manuscript of the map is unknown and probably does not exist. Dr. North gives reasons for his belief that Lhuys's map was not based on angular measurement but that it was founded on one of the editions of the Ptolemy map of Great Britain, or some other maps which was based on Ptolemy. In his compilation Lhuys probably owed some details to Lily's map of the British Isles (1546), Mercator's map (1564) and Nowell's manuscript maps. The basis of the English part of Lhuys's map appears also to be Nowell's, Mercator's and an unknown map related to both.

Coal Measure Rocks

THE Safety in Mines Research Board has published as Paper No. 98 a report by H. M. Hudspeth and D. W. Phillips entitled "Coal Measure Rocks: Part I.—Classification, Nomenclature and Relative Strengths" (London: H.M. Stationery Office. 1s. net). The more important rock structures bearing on the strengths of rocks and on roof control are discussed with special reference to the programme of research on rock falls in mines which was initiated some years ago. The strata are classified into five standard groups—sandstones, siltstones, mudstones, shales and clays—according to grain size and constitution. The general petrological characters of the chief rock types are summarized and also their relative strengths and bending capacities. The varied nomenclature used to describe the rocks in the different coalfields of Britain is listed with a brief description of each term. A scheme of strata notation is suggested which is sufficiently comprehensive to illustrate the rocks met with during coal mining. The report will in due course be supplemented by others dealing with Coal Measure rocks in relation to roof control.

Meteorology of Lower Egypt

In a paper entitled "Temperature and Relative Humidity in the Atmosphere over Lower Egypt" (Prof. Note 75. M.O. 336c. London: H.M. Stationery Office. 2d. net.) Mr. W. D. Flower gives tables of monthly mean values of these quantities from the results of observations made in aeroplanes in the early morning from 1922 until 1930 at three inland stations in Lower Egypt—Helwan, Heliopolis and Ismailia—covering roughly the range 30°-32° north latitude. The observations were made while the aeroplanes were ascending, the time taken to reach the height where pressure was only 650 millibars being about an hour, and the ascents generally began

between 7 a.m. and 8 a.m. local time. Temperature means are for 500-metre intervals, and are based on a good number of observations up to 4,000 m. They show little lag with height in the time of the maximum and minimum of the annual march. There is a gradual increase of temperature from January until August and a rapid decrease in the last three months of the year, but the rate of rise between April and May is retarded above 1,000 m., owing doubtless to a tendency for short periods of very high temperature in April at such levels that has been noted by earlier writers. The mean lapse rate is not very different from that observed in England in the early morning, but observations made in the early afternoon show that it then exceeds the dry adiabatic rate from January until August up to 1,000 m. and exceeds it at times in all months, while in May and June this is often the case up to 2,000 m. The observations of relative humidity show that the mean is so low as 24 per cent at 4,000 m. in August; the mean vapour pressure, however, is higher than that in England at all levels, in spite of the occurrence of such extremely low values as 0.1 millibars at 2,500 m. on one occasion in March and at 3,000 m. once in October. The paper concludes with a discussion of the formation of early-morning clouds in summer, which are attributed to the greater radiation from layers of moist air; they sometimes develop downwards from the top of the moist layer so as to reach the ground and cause fog.

A New Purine in Tea

THE known purines occurring in plants are caffeine $C_8H_{10}O_2N_4$, theobromine $C_7H_8O_2N_4$, and theophylline $C_7H_8O_2N_4$. These may be considered as end-products of purine metabolism in plants. In addition to these, some substances such as adenine and guanine, adenylic acid, uric acid, or guanosine, xanthine and hypoxanthine occur, the non-methylated purines being probably degradation products of plant nucleic acids. While uric acid has long been known as a characteristic oxidation product of purines in animals, it has only recently been found to exist in small quantities in plants (30–250 mgm. per kgm. dry plant). A methyl derivative of uric acid has now been detected for the first time in tea by T. B. Johnson (*J. Amer. Chem. Soc.*, 59, 1261; 1937). A residue from several million pounds of tea obtained in the commercial removal of caffeine was available and from this about 10 gm. of crystals were picked out. These were found by very careful examination, both chemical and crystallographic, to be 1,3,7,9-tetramethyl-2,6,8-trioxypurine, derived from 2,6,8-trioxypurine (uric acid). It had been synthesized by Emil Fischer in 1884. As Prof. Johnson says: "By the discovery of this purine in tea, we not only increase the number of characteristically methylated purines occurring in the plant kingdom to four (theobromine, theophylline, caffeine and tetramethyl uric acid), but we also stimulate a new interest in the possible natural occurrence of other methyl derivatives of this series, and also in the mechanism of the plant metabolism of purines in general."

Sublimation and Condensation of Crystals

T. ALTY (*Proc. Roy. Soc., A*, 161, 68) has investigated the interaction of vapour molecules with a crystal surface by measuring the rate of sublimation of crystals into a vacuum. When the crystal is in equilibrium with saturated vapour the number of molecules incident on the surface can be determined

from the vapour pressure. The number retained by the surface is equal to the number which leave it, and is assumed to be the same as the rate of evaporation in vacuum. The fraction of the incident molecules which condense is called the condensation coefficient. Measurements on liquids have shown that it is nearly unity for benzene and carbon tetrachloride and is of the order 0.04 for water and alcohol. Similarly, the present work shows that iodine and naphthalene have coefficients of condensation unity, while camphor and benzoic acid have much smaller coefficients. The value 0.17 was obtained for camphor. As in the case of the liquids, it seems that non-polar substances have unity values for the condensation coefficient.

A Theory of Ball Lightning

THERE exists a considerable number of descriptions of ball lightning, usually associated with thunderstorms. Th. Neugebauer (*Z. Phys.*, 106, 474) has now produced a theoretical explanation of the phenomenon. He shows that a number of charged particles—electrons and positive ions—may form a compact gaseous mass if the electron density is very high, and of the same order as the density of gas molecules. The mass of gas is held together mainly by the 'exchange forces' of quantum mechanics—the electrons form, under the assumptions made, a non-degenerate gas. The theory shows that the ball may disappear in one of two ways as the electron density falls owing to recombination—either the ball may collapse or it may explode, according to whether the radiative loss of energy keeps pace with the falling exchange forces. These modes of disappearance both occur in the descriptions of ball lightning. The electron density necessary for a coherent ball is much higher than can be attained in laboratory discharges, but it is suggested that it may be reached in lightning flashes of normal type.

Ionosphere Observations in Japan during a Solar Eclipse

THE results of observations on the ionosphere made in Japan during the total solar eclipse of June 19, 1936, are described in a paper by T. Minohara and Y. Ito published in the *Electrotechnical Journal* of October 1937. This journal is an abstract section in English of the *Journal of the Institute of Electrical Engineers of Japan*. The observing station was at Iwamizawa, Hokkaido, and this site was selected because maximum totality of the eclipse occurred in the ionosphere at a height of 260 km. above the observing station. Using the usual type of pulse emitter, the effective heights and critical frequencies of the E , F_1 , and F_2 regions of the ionosphere were measured with automatic recording apparatus covering the frequency range 1.5–15 Mc./sec. The results reproduced in the paper show that the effect of the eclipse was very distinct in the case of the F_1 region, but very obscure in the other cases. The ionization density in the F_1 region was approximately proportional to the exposed area of the sun's disk, thus indicating that the ionization was due to ultra-violet light. In the case of the F_2 region, the ionization increased somewhat during the eclipse, an effect which might have been due to decrease in temperature, with consequent contraction and increase in ionization density in the region of the ionosphere concerned. Alternatively, the effects observed may be attributed to the magnetic disturbance which accompanied the eclipse.

Lubrication and Lubricants

UNDER the auspices of the Institution of Mechanical Engineers, in collaboration with some forty-five other technical institutions and societies, a general discussion on lubrication and lubricants was held in London on October 13-15. The discussion centred around more than a hundred papers contributed by leading authorities throughout the world: the meetings were extremely well attended and the essential objects of the promoters—to review the present state of knowledge and to discuss the major problems of lubrication and lubricants—were attained with a considerable degree of success. Much valuable and interesting information and data were made available, while pleasing evidence was afforded of the great amount of research attention now being given to every aspect of lubrication, also of the growing concern and interest in its problems shown by designers and operating engineers. Not the least valuable feature of the discussion was the interest in, and the divergence of views on, certain fundamental aspects, which will undoubtedly stimulate further research in this field.

An adequate review of the papers, all of which were available at the meeting*, cannot be attempted in a limited space, but it may be useful to give an indication of some of the problems revealed and discussed. For convenience of discussion, the papers were placed into four groups.

JOURNAL AND THRUST BEARINGS

The first group of papers relate to the problems of journal and thrust bearings. Swift describes the application of the results of his modified Reynolds' theory of the journal bearing film to design; he uses the correction for end leakage deduced by Kingsbury from experiments with an electrical analogy apparatus. Boswall gives data for the 120° journal bearing, and Prandtl and Hanocq report experimental work which indicates that partial bushes behave like articulated plane pads. It is apparent that experimental results and theory are in agreement in a general way for thick film conditions in journal bearings. A number of papers deal with the more critical conditions as failure is approached. Needs, also Bradford and Vandegrift, consider the effect of pressure on viscosity, and its relation with friction, pointing out that what might appear to be an 'oiliness' effect of a fatty oil could be due actually to the smaller effect of pressure on its viscosity. This pressure effect on viscosity can only become material, however, when the film thickness is of the order of 1μ , and the irregularities of the surfaces with present-day standards of finishing begin to affect the behaviour as this thickness is approached. Moreover, Kyropoulos mentions another complicating phenomenon in the decrease of viscosity which accompanies flow-orientation of a lubricant consisting of long-chain molecules. Heidebroek and Brillé describe the local interference of surface irregularities with the film pressure development, and the latter refers to the increase of friction due to oil whirls which, he considers, are formed in the tiny valleys of the surface.

* Institution of Mechanical Engineers. General Discussion on Lubrication and Lubricants. Group 1: Journal and Thrust Bearings. Pp. 500. 2s. 6d. Group 2: Engine Lubrication. Pp. 216. 2s. 6d. Group 3: Industrial Applications. Pp. 162. 2s. 6d. Group 4: Properties and Testing. Pp. 222. 2s. 6d. (London: Institution of Mechanical Engineers, 1937.)

Experimental work on the approach to failure is included in the papers by Tenot and Jakeman and Fogg, the latter showing the effects of the usual variables on 'seizing' temperature; also Clayton shows how the change of shape of the bush due to running-in increases the safety of a bearing. Guy and Smith, also Soderberg, describe current practice regarding turbine bearings, emphasizing the cooling function of the oil. These authors mention the troublesome vibration which occurs with these lightly-loaded high-speed bearings, and Newkirk refers to suggested means of combating this difficulty; it is apparent that the phenomenon is not yet fully understood. Risk of ignition of escaping oil due to contact with the hot parts of a turbine is considered by Chittenden; with the view of avoiding this difficulty Samuelson has carried out experiments with a water-base lubricant, and shows that the bearing performance is in some respects improved, even though the viscosity is only one tenth of that of the usual oil. Guy and Smith refer to the great need for co-operative research into bearing behaviour under the high-speed conditions of turbine operation.

Thrust bearing design is based mainly on Michell's original work. Reference may be made to the use of pivoted pads for journal bearings (Gibson), and to the mass-produced, low-friction Nomy bearings (Odqvist), which work on the Michell principle but have rotating instead of stationary pads. Linn and Sheppard describe a thrust bearing in which the pressure film is induced by tapering the leading edges of the lands, there being no tilting elements. Several papers describe the use of synthetic resin bonded materials, and two the use of rubber, for journal bearings, both being water-lubricated.

INTERNAL COMBUSTION ENGINES

In the section devoted to the lubrication of internal combustion engines, many papers deal with bore wear, and it is apparent that both corrosion and abrasion are involved. The much greater wear due to starting than to running is brought out by Yeates. On the other hand, Taub and Young do not consider that corrosion is normally the main cause of wear. Everett and Keller refer to the very sensitive iron contamination method of measuring wear. Williams shows that lower viscosity gives higher wear under cold conditions, but this may be offset to some extent by the more rapid arrival of a thin oil after starting; Barrington and Lutwyche show the decrease of cranking torque with decrease of viscosity. Bass, Bouman and Norlin agree that 'oiliness' dopes have little effect, though Taylor considers the piston rings to operate most of the time under boundary conditions in which 'oiliness' dopes would be expected to have an effect. Rosen, however, shows that anti-oxidation dopes reduce wear considerably, and Barrington and Lutwyche show a decrease of cranking torque due to additions of oleic acid, but not with compounded oils.

Opinions differ on the question of oil consumption. Taub advocates plentiful supply to the cylinder with drastic scraping by high-pressure rings, while Ottaway does not favour high-pressure rings and regards limitation of the supply from the big-ends

as necessary. Taylor suggests that the sudden increase of consumption at high speeds is due to change from boundary to fluid film conditions, but Taub ascribes it to ring flutter.

The problem with internal combustion engine bearings is temperature rise. White-metals lose fatigue strength rapidly with increase of temperature (Macnaughtan, Williams), and consequently crack in service unless the temperature can be kept down. Williams gives results of actual temperature measurements in the bearings of an engine, showing the increase with increase of speed and inlet oil temperature, and decrease with increase of oil flow. Neave and Sallitt review the various copper-bearing alloys, including lead bronze, which is often used as a substitute for white-metal under high-duty conditions. Mickelsen suggests that, in view of the importance of cooling, it might be possible to lubricate the bearings with water or a water-oil mixture.

Several papers deal with filtration and oil purification by various types of apparatus, including de Langen's magnetic filter for removing iron particles. The importance of removing the fine particles which get into the clearance spaces of bearings is being realized, though it is difficult to achieve this with a filter of reasonable size.

RECIPROCATING STEAM ENGINES

Turning to the subject of the lubrication of reciprocating steam engines, the French and German State railways consider that various grades of superheated cylinder oil are desirable according to the degree of superheat in the cylinder, whereas Canadian National and English railways use only one grade; the majority favour compounded oils, the decomposition products of the fatty oil being thought to form stable and resistant boundary films. The oil is now supplied by pump instead of by a hydrostatic system, but there is some difference of opinion between the English and French railways as to the part of the stroke at which it is best to supply the oil.

In marine practice, according to Freeman, superheated steam valves, pistons and liners are lubricated by mechanical lubricators feeding into the steam pipe or round the high-pressure liners. Auld and Nicholson deal with oil circulation systems, and the changes that may occur in the oil. Nicholson emphasizes the advantages of a small amount of oil of the correct type properly applied; overfeeding may result in deposits in the cylinders and steam chests.

H. J. G.

[To be continued.]

Adult Education in the United States

ADULT education has been much discussed of late, especially from the point of view of education for citizenship in a democracy. This is a point of view now very widely canvassed in America, having found an enthusiastic advocate in Dr. J. W. Studebaker, the United States Federal Commissioner of Education. A year ago his bulletin "Education for Democracy: Public Affairs Forums" was noticed in these columns, and an appreciation of the 'Forum' system, based on six weeks' personal participation, by the secretary of the British Institute of Adult Education, was published in Bulletin No. VII of the World Association for Adult Education. The Forums are organized within the framework of the public school system under the control of the local education authority and are conducted by expert leaders using varying techniques according to the size and composition of the membership. Addressing the National Education Association last February on "Crucial Issues in Education" (Pamphlet No. 74. Superintendent of Documents, Washington. Pp. 20. Price 5 cents), Dr. Studebaker announced that nineteen public forum demonstration centres, officially sponsored by him and financed, as a temporary measure, with federal funds, were operating in as many States. In the preceding five months more than 350,000 people had attended 3,854 forum meetings.

Closely associated with the public affairs forums is the Commissioner's educational radio service, exemplified by a series of thirteen half-hour dramatic items broadcast on Monday evenings at 10.30, having as their theme, under the title "Let freedom ring", the "long struggle for the rights and liberties set forth in the Bill of Rights of the Constitution of the United States". The Commissioner stated that his office had received in seven months, in connexion with this radio service, 250,000 communications from

radio listeners. A radio script exchange service has been organized, moreover, and "hundreds of student groups are adapting and rewriting these radio scripts for their own productions", in association with dramatic art and social science classes and radio workshops. The Commissioner announced that he had officially made a request for the reservation in Washington of certain high-frequency wave-lengths for the exclusive use of local educational agencies and for the free discussion of civic affairs.

The address terminated on a note of urgency: "There is no time to lose. These programmes for popular enlightenment in the protection of popular self-government must be promoted in every State and community. I leave this crucial issue upon your conscience." The issue in question, arising out of the conflict between dictatorship and democracy, "a major conflict which is swiftly reaching the stage of a crisis throughout the world" is elsewhere phrased as "What more can education do to undergird American democracy".

One of the speakers at a discussion on adult education in the Education Section of the British Association at the recent meeting in Nottingham suggested that education unrelated to a specific social ideal is, in our day, an impossibility, that real education must be propagandist, aiming either at assisting to maintain stability or at preparing for change, and that adult education, to be a live force, must support "the organized working-class movement". Dr. Studebaker's adult education policy is frankly propagandist but exposes the fallacy of representing the aims of stability and change as mutually exclusive. He defines education's social ideal as a society where the majority will be law and in which the right and privilege of the minority to advocate a change are protected.

A New Hydro-Electric Power Scheme in Sweden

A FULL description of the hydro-electric power scheme at Krangede, Sweden, which has been in operation for six months, is given in the *Asea Journal* of May and June, published by the Asea Company of Vasteras. Krangede is situated in about lat. 63° N. at the site of a natural fall on the lower part of the Indalsälven, an important river in the Jamtland district of Sweden draining a large area containing many lakes and extending back to the Norwegian borders. The link with the power station lies well up in 'Norrländ', and in the south consists of a high-voltage feeder carried direct down to a main substation at Horndal in South Dalecarlia. It is thus within convenient range of Stockholm and is in touch with the large supply networks of central and southern Sweden.

It was anticipated long ago that before 1940 the demand for electrical energy in the southern and middle parts of Sweden would make the delivery of large bulk supplies from the north economically feasible. The great industrial activity of the last few years has accelerated the increasing demand for electrical power. The Krangede scheme was carried out and is owned by a private company comprising several large industrial businesses and the Stockholm municipality. The scheme has several unique features. The whole generating plant is underground, and the equipment is of the most modern design, as it has to deal with a transmission voltage of 220 kilovolts.

Unregulated, the water flow in the river at Krangede is very variable. The maximum flow is about 2,000 cubic metres per second and the minimum is often only about 100 cubic metres per second. Work at present proceeding on one of the lakes near the source of the river on the Norwegian borders is expected to increase the minimum flow by about 40 per cent. The power station is designed for a head of 190 feet, and with the plant at present installed it has a consumption of about 140 cubic metres per

sec. The dam has a length of about 240 yards and has four spillways. The generating plant is housed in a chamber blasted out of the solid rock, the machine room floor being 131 feet below the surface of the ground.

To prepare a turbo-alternator for starting, a special switch is operated and a window in it becomes illuminated by a flickering light. Until the lubricating oil and cooling water are circulating properly and other starting devices have moved into the starting position, this light goes on flickering. When everything is ready to start up the turbine, the light becomes steady. The control room is situated on the top story of the building and its windows command a good view over the outdoor switchgear and the dam. A mimic busbar system is provided at the control desk and includes switches and position indicators. On the front of the control desk are push-buttons controlling the operating of the system.

The two generators at present working are each of 35,000 kilovolt ampere capacity when running at 167 revs. per min. The height of each generating unit is nearly 30 feet and its total weight is 427 tons. The main transmission line connects the generating station to the Horndal substation, and as the transmission conductors work at 220 kilovolts, it was necessary to make their diameters large so as to avoid the formation of coronae (brush discharges) on them. The supporting towers are 56 feet in height and the conductors are hung on suspension type insulators with sixteen insulators per string. The normal span is 263 yards and the spacing between the phases 23 feet.

The official tests made on the generators at full load and a pressure of 8,400 volts gave an efficiency of 97.8 per cent at unity power factor. The voltage wave generated is practically sine shaped, the maximum deviation from this form being only about one per cent.

Woods on Private Estates

IN his presidential address as chairman of the Department of Forestry of Section K (Botany) at the meeting of the British Association at Nottingham, the Hon. Nigel Orde-Powlett took as his subject "The Present and Future of Estate Woodlands". Mr. Orde-Powlett first dealt with the value of the existing private woods to Great Britain during the Great War, pointing out that although the Forestry Commission is now planting on some scale, its area under forest is only one eighth of the nominal woodland area of the country, the remainder being privately owned. It is therefore a matter of vital national urgency that it should be made possible for owners to institute a wise forest policy on their estates. There is also the social aspect of the problem—the drift from country to town. This is due to many causes, but Mr. Orde-Powlett holds the opinion that woodlands afford employment which is congenial, and that well-managed woods can afford to give adequate pay to the staff maintained. Since the

majority of the private woodlands are not run on business lines they are under-staffed. If properly run, many thousands of additional men could be employed, with an increase of small-holders—and the forest worker forms the best type of small-holder.

The attitude of the private owner of woodlands varies. Most woods are run at a loss and their owners are incredulous as to their financial possibilities; or they are regarded as a nest-egg only to be realized in dire necessity; or the owner is averse from even cutting a single tree. It has been estimated that the average annual output per acre in Great Britain is less than 20 cu. ft., whereas under good management three to four times that volume might be produced.

There are three causes for this position, says Mr. Orde-Powlett, and all of probably equal importance. The first, and it may be asserted in the interests of continuity and good forest management, the most important, is taxation, and especially the death duties. It is true that duties are not payable on the

timber until the woods are felled; but on a private estate, although the woods may form only a portion, perhaps only a small percentage, of the total area, they may yet have to pay a share of the duties out of all proportion to the income of the person concerned. This spells chaos in management and precludes an owner from having a proper 'working plan' in force, since death will probably result in its clauses becoming unworkable. In other words, continuity in the management of the woods is an impossibility. Moreover, as under the present system of taxation every proprietor knows that in the course of three or four generations the estate must be broken up, there is no encouragement towards correct woodland management. Mr. Orde-Powlett suggested conditional remission of death duties on agricultural land, the condition being that the sum so remitted should be spent on improvements which would be defined over a period of years.

Another cause is the neglect of owners to thin their woods properly and so obtain an intermittent revenue and also to fell the timber when it has reached maturity for market purposes. In this connexion, it has been suggested that all woodlands should be taken over by the State. Not only is this in opposition to the ordinary forestry economy in those European States where the best forest management is in force, but also it would be quite impracticable in Great Britain; and the same objections apply to the introduction of any form of compulsion on the part of the Government.

Mr. Orde-Powlett dealt with the present assistance available from the woodmen's training schools in existence, with the efforts of the various forestry societies, and the new type of consultant forester of which there are now a few firms. Good as is the work done by all these, their efforts only apply to those

owners whose interest in their woods is already awakened. The majority do not fall within this category. As Mr. Orde-Powlett says, "a real comprehensive improvement depends on the arousing of forest consciousness amongst owners and in providing them with means to acquire knowledge". He advocates the establishment by the Forestry Commission, at a cost of twenty thousand pounds or so a year, of a comprehensive advisory service throughout the country.

"I would have woodland advisers, highly trained foresters, each with his area of country," says Mr. Orde-Powlett. This would be an excellent scheme if it was inaugurated by the owners themselves, a group of owners in a locality engaging and paying the salary of the highly trained woodland adviser. Otherwise, if engaged by Government (a sum of £20,000 is to cover salaries, offices, etc.) what prospects of a career would these advisers have? Even if such a service were inaugurated, what continuity to their work could be assured, as Mr. Orde-Powlett points out, with estates being broken up and dispersed in four generations, if not sooner, as a result of death duties. It would be quite impracticable for the State then to step in and take over as a working proposition small areas of woodland, however good the local management may have been, scattered all over the country.

If the Government has a real belief in the possibilities of forestry or its necessity in the interests of the community, the land must be so taxed that a continuity of management—and in forestry this means a continuity throughout a century and more—is assured. Without such an assurance it is difficult to see how the expenditure of public money in the interests of the private landowner can be justified.

Fibre Cores in Winding Ropes

WE have received the Safety in Mines Research Board Paper No. 97 upon "The Effect of Fibre Cores on Internal Corrosion in Colliery Winding Ropes", by J. E. O. Mayne*. The author states that the fibres used for the cores belong to the 'hard' group, the object of which is to provide a firm support for the steel strands of the rope. The material arrives in Great Britain in bales containing a number of so-called 'heads' and are subjected to the following four processes: (1) 'hackling', (2) spinning the fibre into yarn, (3) spinning the yarn into strands, and (4) spinning the strands into a complete core. To enable the fibre to be spun, it must be wetted by a so-called 'batching' fluid, which is 5-15 per cent of the weight of the fibre in thin mineral oil; the core is then treated with heavy mineral oil, which forms a lubricant; severe internal corrosion has been found in ropes containing Stockholm tar, and this material should on no account be used; this is perhaps one of the most valuable observations in the whole work. It is stated that "It is understood that the use of coal tar is also objectionable."

The author, who has experimented upon the subject

for some time, arrives at the following conclusions:

"(1) Batching and impregnating oils used in core manufacture do not decompose sufficiently, in practice, to cause appreciable corrosion of wire; on the contrary they protect it. (2) Darkening of the oils is due to the presence of impurities such as coal dust and iron oxide, and the oils retain their protective value until they are squeezed out. (3) Internal corrosion can take place without penetration of the rope by water containing harmful salts or acids derived from sources external to the rope. (4) Manila (and some other) fibres used for cores contain and are liable to develop formic and acetic acids as a result of bacterial action. (5) These acids can corrode wire ropes in the presence of moisture, even in the absence of oxygen; pressure between wire and core tends to accelerate the rate of attack, since it tends to remove the protective oils and increase the contact between fibre and steel. (6) The erratic distribution of corrosion is due to the sporadic nature of bacterial action. (7) Most of the harmful acid in raw manila fibre can be removed by cold water treatment, and it is suggested that subsequent bacterial action might be prevented by treating the washed fibre with an antiseptic which would not corrode steel. The practicability of these preventive measures has not yet been demonstrated."

* Mines Department: Safety in Mines Research Board. Paper No. 97: The Effect of Fibre Cores on Internal Corrosion in Colliery Winding Ropes. By J. E. O. Mayne. Pp. 38+4 plates. (London: H.M. Stationery Office, 1937.) 1s. net.

Science News a Century Ago

Instructions for Travellers

In the *Athenæum* of November 11, 1837, a note said: "In the instructions drawn up by the scientific men of France, for the use of the two vessels, the *Astrolabe* and the *Gélee*, which are about to circumnavigate the globe, we perceive that Mr. Ward's plan of transporting plants is highly recommended, as well as that of Mr. Luschnath, which can also be applied to seeds, in order to preserve their germinating powers. M. de Blainville eagerly requires microscopic marine animals, the *Spirula* with its inhabitant, that of the *Nautilus flammea*, which is wanting in the collections in France, parasitical insects and worms; and strongly urges experiments to be made on the temperature of living man, and beings of an inferior order, under different circumstances. . . . He sets forth the important novelties likely to be found in New Guinea, the Moluccas, and Celebes, in the creeks and bays of which probably exist a multitude of fishes and Mollusca, and particularly requests the acquisition of the Apterya, from the New Holland region, which is supposed not to have any wings. . . . M. de Freycinet recommends hydrography, observations of the tides and currents, such descriptions of the countries visited as will set forth their resources to future navigation . . . and M. Corder states the ignorance which prevails concerning the southern hemisphere, and the consequent value of the smallest atom of rock from this quarter."

Hybrid Ferns

In the *Athenæum* of November 11, 1837, it is stated that "A triumph has been obtained by M. Martens, the professor of chemistry at the University of Louvain, and Dr. l'Herminier, over those who assert that no hybrid plant can be produced where no stamina exist. The former shook the fronds of the *Gymnogramma calomelanos*, and the *G. chrysophylla*, reciprocally over each other, at the time when the fructification was fully developed, and thus produced a new plant which is to be called *G. Martensii*. It is worthy of remark that the hybrid plant bids fair to be easily propagated in our greenhouses, while the parents constantly languish and die. While M. Martens was making his experiments at Louvain in Belgium, Dr. l'Herminier watched the same process taking place naturally in the woods and savannahs of Guadaloupe, and sent some dried fronds (in excellent preservation) of the hybrid to M. Bory St. Vincent."

The Moon's Equatorial Horizontal Parallax

ON November 11, 1837, Thomas Henderson, Astronomer Royal for Scotland, read a paper to the Royal Astronomical Society entitled "The Constant Quantity of the Moon's Equatorial Horizontal Parallax, deduced from Observations made at Greenwich, Cambridge and The Cape of Good Hope in 1832 and 1833." Previous to this, by using a method based on the theory of gravity, Burchardt had found that the constant part of the lunar parallax under the equator amounted to $57' 0''$ while Damoiseau arrived at $57' 0.9''$ for the constant and Plana computed it at $57' 3.1''$. By another method founded on observations made simultaneously at different parts of the earth, Lacaille had obtained $57' 4.6''$, Lalande $57' 3.7''$ and Du Séjour $57' 6.0''$. While at the Cape

in 1832-33, Henderson determined a great number of declinations of the moon with the view of arriving at a more accurate value of this element, and by a comparison with his own observations made at Greenwich and Cambridge, obtained $57' 1.8''$ for the constant of the equatorial parallax.

Observations on Rain

THE issue of the *Gentleman's Magazine* of November 1837, contains the following account of a paper recently communicated at a meeting of the Warwickshire Natural History and Archaeological Society: "The Rev. G. Childe made public his observations on Rain. He said it was a general but erroneous opinion that the greatest quantity of rain that fell in any month of the year fell in February. From his own observations (during eight or more years) he ascertained that in July was the greatest quantity, September second, August third, October fourth, June fifth, April sixth, November seventh, May eighth, February ninth, instead of first, December tenth, January eleventh and March twelfth. It would be found that if there were a deficiency of rain in the winter months December, January and February, that deficiency would be in great part compensated by an excess in the three summer months July, August and September."

University Events

CAMBRIDGE.—Dr. H. Brück, of the University of Berlin, has been appointed first junior observer in the Solar Physics Observatory.

W. G. Palmer, of St. John's College, has been approved for the degree of doctor of science.

It is proposed to confer the degree of M.A. on Dr. D. G. Catcheside, University lecturer in botany, and S. D. Elliott, University demonstrator in the Department of Pathology.

Miss M. L. Tomlinson has been elected to a staff fellowship at Girton College.

OXFORD.—On November 2 in Congregation the degree of M.A. by decree was conferred on Lord Nuffield, so that he is now a full and voting member of the University.

On November 16 the Chancellor will preside at the Congregation at which Lord Nuffield will be thanked for his recent gifts. There will then be voting on the decrees relating to the new benefaction to the medical school and promulgation of the statute relating to the gifts to the proposed Nuffield College (see p. 799) and the chemistry school.

Dr. L. J. Witts has been appointed Nuffield professor of clinical medicine as from 1938.

H. J. B. Atkins, Trinity College, R. B. Scott, Brasenose College, A. W. D. Leishman, University College, and E. P. Edmonds, Keble College, have been granted the degree of M.D.

J. G. Daunt, Exeter College, has been awarded the Scott scholarship for research in physics.

The curators of the University Chest have been authorized to receive from the Rockefeller Foundation in the year beginning October 1, 1937, a sum not exceeding 3,000 dollars as a contribution towards scientific apparatus, material and special cages for primates required for research in the Department of Human Anatomy.

Societies and Academies

Paris

Academy of Sciences, September 13 (C.R., 205, 473-500).

GABRIEL BERTRAND: The presence and distribution of boron in the potash salts of Alsace. The quantities of boron found ranged from 1 to 10 parts per million in the salt, and from 50 to 500 parts per million in the interposed clay sheets.

ALBERT F. BLAKESLEE: Doubling the number of chromosomes in plants by chemical treatment.

J. G. VAN DER CORPUT: The Goldbach-Vinogradov theorem.

OCTAV ORICESCU and GH. MIHOC: The asymptotic trend of the sum of the variables of a discontinuous Markoff chain.

PAUL PÉTRY: The interpretation of observations and measurements relating to breakers. Study of the forces produced by waves striking a breaker and of the velocities of the parts of the breaker.

PIERRE ERNEST MERCIER: Parameters and characteristic curves of carceening with circulation.

JEAN HÉLY: The gravific wave induced by an electromagnetic wave in a refracting medium.

JEAN CAYREL: Absorption measurements of thin plates of copper sulphide. Application to the comparison of their thicknesses.

HUBERT GARRIGUE: New results on the green, yellow and red radiations emitted by the night sky.

ROGER LAMBERT: The Miocene of Boutoutou, Niger Colony.

ANTOINE DE CUGNAC: A new hybrid of bromegrass obtained experimentally. The uncertainty of the systematic determination of spontaneous hybrids.

MARCEL AVEL: The experimental study of the part played, in the regeneration of the head in worms, by the old parts in the immediate neighbourhood of the surface of amputation.

C.R., 205, 501-528.

EMILE BOREL: The regular distribution of the points of a linear enumerable ensemble.

LOUIS LAMIQUE: Neuro-muscular isochronism as an empirical fact. Historical résumé of work in this field, with special reference to objections raised by A. V. Hill.

GEORGES CHARPY: The determination of silicon in steels. In a specification giving a maximum figure for the silicon allowed, it is essential that the method of analysis should be given. Examples of the differences introduced by the method of analysis are given.

ANTOINE APPERT: Nearly isometric measurement.

GEORGES CALUGARÉANO: Invariants of prolongation connected to integral functions.

CHARLES SCHMERBER, PIERRE TARDI and PAUL CAILLOL: A method of measuring angles by fractional repetitions.

MAURICE FALLOT: The magnetic properties of alloys of iron and iridium. Determinations of the Curie points, points of transformation and ferromagnetic moments show a close resemblance with the analogous properties of the alloys of iron with ruthenium and with osmium.

Mlle. YVETTE CAUCHOIS: Study of the *Lz* satellites for some heavy elements and rare earths.

PIERRE NOBÉCOURT: Cultures in series of plant tissues on artificial media.

MARCEL AVEL: Study of some complex cases of regeneration of the head in worms.

CH. BRIOUX and EDG. JOUIS: Diacetyl in Normandy butters. Results of the examination of 150 specimens.

Moscow

Academy of Sciences (C.R., 15, No. 8, 1937).

L. B. ROBINSON: A system of Riquier and the tensor calculus.

J. D. DUBNOV and N. EFIMOV: Single geodesic grids and the Lie surface.

V. KOZLOV: A relation between the absolute convergence and the unity of trigonometrical development.

H. HILMY: The ensembles of movements that cannot be represented as sums of invariant positive ensembles.

A. L. ŠAGINJAN: The theory of orthogonal polynomials in a variable complex.

S. MICHLIN: On a certain problem of the theory of singular integral equations.

N. REIN: The Whittaker integral and the periodic solution of the problem of three bodies.

J. MALKIN: The stability of movement in Liapounoff's sense.

V. A. GAVRILENKO: Comparison of experimental and theoretical curves showing distribution of velocities in turbulent uniform flow through pipes.

N. AKULOV: The theory of dependence of the ferro-magnetic properties of metals on temperature.

V. FABRICANT: The theory of radiation of a gaseous discharge.

E. KUNDORSKIJ: The problem of the nature of coercive force.

N. A. ŠIŠAKOV: Standard substances for exact measurements in the electron diffraction method.

D. I. MIRLIS: Kinetics of wetting and linear corrosion of metals in polyphase systems: metal-liquid-liquid and metal-liquid-gas (3).

V. G. KUZNECOV: Röntgenographical investigation of anomalous solid solutions of ammonium chloride in the chlorides of manganese, cobalt and nickel formed in aqueous solutions.

J. L. GOLDFARB and M. V. ANDRIJCHUK: Condensation of α -aminonicotine with ω -bromoacetophenone.

V. I. NIKOLAJEV: Chemical signs of the presence of salt deposits and the method of their physico-chemical investigation.

B. N. MAKHAJY: Algae as characteristic fossils.

I. A. SMORODINCEV and S. A. PAVLOV: The method for the determination of the coefficient *D*.

I. A. SMORODINCEV and A. M. FELDT: Determination of the isoelectric point of thyroglobulin.

B. A. RUBIN, N. M. SISAKIAN and O. T. LUTIKOVA: Measurement of the oxidizing-reducing power of living vegetable tissue.

A. ZAMORSKIJ: Algebraic symbolism of the law of hybridization.

S. MEDVEDEVA: The toxins of *Fusarium bucharii* Jacz. and *Fusarium graminearum* Schw.

V. M. KATUNSKIJ: Dependence of photoperiodic reactions of plants on the spectral composition of light.

L. V. ARNOLDI and K. R. FORTUNATOVA: A contribution to the experimental study of the nutrition of Black Sea fishes.

S. E. KLEINENBERG: Distribution of some fishes and of *Idothea algerica* Lucas in the eastern part of the Black Sea.

P. L. PIRAZNIKOV: A contribution to the study of the origin of northern elements in the fauna of the Caspian Sea.

A. A. VOITKEVIČ: The morphogenetic activity of different parts of the hypophysis (5). Experiments with the implantation of substances from the 'eosinophilous zone' of anterior lobes of hypophysis on tadpoles under natural conditions.

Rome

National Academy of the Lincei (*Atti*, 25, 197-244; 1937).

T. LEVI-CIVITA: Canonical forms of the ds , binaries with a given total curvature.

L. AMERIO: Some complements of the theory of the Laplace transformation.

S. MARTIS IN BIDDAU: Functions of linear operators (1).

I. POPA: Projective-differential geometry of the singularities of plane curves.

G. RACAH: Lagrangian form of electromagnetic forces.

C. TOLOTTI: Problems of plane elasticity with a polydrome Airy function.

P. UDESCHINI: A relative solution to the expansion of the universe.

L. GIALANELLA: Results of the new longitude determination of the axis of the Senatorial Tower of the Capitol and of the Tower of the First Meridian of Italy at Monte Mario.

Atti, 25, 253-348; 1937.

G. ABETTI: Height of the chromosphere in 1936, and the progress of the solar cycle.

S. MARTIS IN BIDDAU: Functions of linear operators (2).

M. PASTORI: Influence of small viscosities of a fluid in the determination of pressure in single regions.

V. ZAGAMI: Experimental researches on the seminal liquid. Value of the pH of normal human seminal liquid.

E. BIANCHI: Commemoration of the Dalmatian astronomer Ruggero Giuseppe Boscovich.

G. A. MAGGI: Tangential derivatives of the potential function of surfaces.

G. ARMELLINI: Reduced problem of two bodies of variable masses.

U. CASSINA: An integral-differential equation.

A. DE MIRA FERNANDES: A formal aspect of the tensorial derivation.

E. FROLA: Functional linear transformations and singular integral equations.

M. HAIMOVICI: Metric spaces with an allied connexion.

A. PUPPO: Researches on the solar radiation at Col d'Olen (1).

A. MANGINI: Aromatic nitroderivatives (12). The action of some hydrazines on 1-chloro-2:4-dinitronaphthalene.

G. MARTINO: Probable existence of an unknown alimentary factor which stimulates sexual development.

M. ROMANO: Contribution to the study of the skin of anurans during metamorphosis.

G. SCHREIBER: Definition of the stages in the metamorphosis of *Bufo vulgaris*.

Sydney

Royal Society of New South Wales, September 1.

E. C. ANDREWS: The structural history of Australia during the Palaeozoic.

H. W. WOOD: Note on the Shortt clock at Sydney Observatory.

F. LIONS: Synthetic substances allied to strychnine.

G. K. HUGHES and F. LIONS: The synthesis of 2-aminomethyl-benzimidazole and related substances.

Vienna

Academy of Sciences, July 1.

F. WESSELY and K. SCHÖNOL: Chasmanthin.

H. PETTERSSON: Abundance ratio of thorium to uranium in rocks and in the sea. The abundance ratio of thorium to uranium is less in the sea than in rocks of volcanic origin. This is ascribed to the precipitation of thorium along with iron from sea water. In agreement with this view, the amount of thorium in sedimentary rocks is relatively high. The precipitation of ionium along with thorium may account for the ratio of radium to uranium in sea water being less than the equilibrium value.

J. SCHINTLMAYER: Shortening of the range of polonium α -particles by oblique emission from the source. The mean range is greatly influenced by the purity of the preparation and the angle of emission; the extrapolated range, however, is not affected. The effect of oblique emission on mean range persists even with very pure preparations.

W. JENTSCHKE and G. STETTER: Short-range particles emitted when polonium α -particles are scattered by heavy nuclei. These particles are probably scattered α -particles, the range of which has been shortened by oblique emission from the source.

J. HOFFMANN: Photochemical changes in phosphate compounds.

MARIETTA BLAU and HERTHA WAMBACHER: Photographic study of cosmic rays: occurrence of proton-like tracks corresponding to a range in air of several metres.

H. KUN and O. PECZENIK: Oral administration of male sex hormone, alone and in combination with female hormone. Study of the electrical rat test.

O. PECZENIK and L. POPPER: Posterior lobe of the hypophysis and the thyroid gland. The excitation of the sympathetic by thyroxine can be prevented by the parasympathetic action of vasopressin.

H. DOSTAL: Reaction kinetics of chain polymerizations.

L. POLLAK and GABRIELE FLAUM-FEHER: The distribution of sugar in the body, and the action of insulin. Phlorizin diminishes the absorption of injected galactose into the organs of the body, but has no effect on the absorption of xylose. This action of phlorizin is inhibited by insulin.

H. KONZETT: Promotion of sleep and narcosis by dyes. Certain dyes, which are not themselves narcotics, are able to reduce the minimum dose of a narcotic required to produce unconsciousness.

E. AHL and O. SCHINDLER: *Pyrrhulina macrolepis* sp. nov. (Pis., Microcyprini).

F. LIEBEN and BELLA BAUMINGER: The combination of sugar and amino-acid.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 8

ROYAL GEOGRAPHICAL SOCIETY, at 5.—J. A. Steers: "The Culbin Sands of the Moray Firth".

UNIVERSITY OF LEEDS, at 5.15.—Prof. H. H. Read: "The Natural History of Metamorphic Rocks".*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Prof. A. I. Virtanen: "Biological Nitrogen Fixation" and "Production of Vitamins in Agriculture" (succeeding lectures on November 10 and 12).*

Tuesday, November 9

ROYAL COLLEGE OF PHYSICS, at 5.—Dr. Harold Scott: "Conquest of Disease in the Tropics" (Fitzpatrick Lectures. Succeeding lecture on November 11).

PHARMACEUTICAL SOCIETY, at 8.30.—Dr. T. A. Sprague: "Early Horbals".

ROYAL ANTHROPOLOGICAL INSTITUTE (at the Royal Society, Burlington House, London, W.1), at 9.—Prof. H. J. Flourens, F.R.S.: "Racial Evolution and Archaeology" (Huxley Memorial Lecture).

Wednesday, November 10

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Colour Films of Tibet, taken by B. J. Gould.

ROYAL SOCIETY OF ARTS, at 8.15.—Sir Ambrose Fleming, F.R.S.: "Giuglielmo Marconi and the Development of Radio Communication".

Thursday, November 11

ROYAL ASIATIC SOCIETY, at 4.30.—(at the Royal Geographical Society).—Sir Aurel Stein: "A Journey of Archaeological Exploration in South West Iran (1935-36)".

Friday, November 12

ROYAL INSTITUTION, at 9.—Sir Daniel Hall, K.C.B., F.R.S.: "Soil Erosion: the Growth of the Desert in Africa and Elsewhere".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT to develop the Information Department and Library Service of the British Non-Ferrous Metals Research Association.—The Secretary, B.N.F.M.R.A., Regent Buildings, Euston Street, N.W.1.

LECTURER IN ORGANIC CHEMISTRY in the City Technical College, Liverpool.—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (November 19).

SENIOR RESEARCH WORKER in the Institute of Animal Pathology, Milton Road, Cambridge.—The Secretary (November 27).

LECTURER IN ORGANIC CHEMISTRY in the University of Melbourne.—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

Official Publications Received

Great Britain and Ireland

Imperial Bureau of Plant Genetics: Herbage Plants. Bulletin 22: Technique of Grass Seed Production at the Welsh Plant Breeding Station. By Gwilym Evans. Pp. 30+8 plates. 5s. Bulletin 23: Production of Seed of Herbage and Forage Legumes. Edited by R. O. Whyte. Pp. 48+1 plate. 5s. Bulletin 24: Collection of Native Grass Seed in the Great Plains, U.S.A. By E. J. Crider and M. M. Hoover. Pp. 16. 2s. (Aberystwyth: Imperial Bureau of Plant Genetics, Herbage Plants.) [1910]

Technical Publications of the International Tin Research and Development Council. Series A, No. 60: A Plane Binding Apparatus with Interferometer Strain Recorder for Metallurgical Investigations. By J. W. Cuthbertson. Pp. 14. (London: International Tin Research and Development Council.) Free. [1910]

Forest Bibliography to 31st December 1933. Part 2: Silviculture (continued); 3: Natural Reproduction; 4: Artificial Reproduction; 5: Tending; 6: Silvicultural Systems; 7: Notes on Trees. Pp. 11+79-190. (Oxford: Department of Forestry, The University.) 12s. 6d. net. [1910]

Ministry of Health. Fourth Report of the Joint Advisory Committee on River Pollution. Pp. 18. (London: H.M. Stationery Office.) 3d. net. [1910]

Ministry of Health and Scottish Office. Inland Water Survey (Committee: Second Annual Report, 1936-37. Pp. 28. (London: H.M. Stationery Office.) 6d. net. [2010]

Medical Research Council. Special Report Series, No. 226: Medical Uses of Radium: Summary of Reports from Research Centres for 1936. Pp. 41. (London: H.M. Stationery Office.) 1s. net. [2010]

Technical Publications of the International Tin Research and Development Council. Series A, No. 61: The Constitution of Tin-Rich Antimony-Cadmium-Tin Alloys. By Prof. D. Hanson and Dr. W. T. Pall-Walpole. Pp. 44+8 plates. Free. Series A, No. 62: A Study of the Mechanical Properties of Tin-Rich Antimony-Cadmium-Tin Alloys. By Prof. D. Hanson and Dr. W. T. Pall-Walpole. Pp. 18+1 plate. Free. (London: International Tin Research and Development Council.) [2110]

Metallurgical Abstracts (General and Non-Ferrous). Vol. 3 (New Series). Edited by G. Shaw Scott. Pp. viii+897. (London: Institute of Metals.) £4, inclusive of 2 "Proceedings" vols. [2110]

Education in 1936: being the Report of the Board of Education and the Statistics of Public Education for England and Wales. (Cmd. 5564.) Pp. xii+200. (London: H.M. Stationery Office.) 3s. 6d. net. [2110]

National Institute of Poultry Husbandry. Bulletin No. 14: Table Poultry Production. By A. J. Macdonald and Jean W. T. Kay. Pp. 21. (Newport, Shropshire: Harper Adams Agricultural College.) 6d. [2310]

Other Countries

Colony of Mauritius: Department of Agriculture. Seventh Annual Report of the Sugarcane Research Station for the Year 1936. Pp. 45. (Port Louis: Government Printer.) 60 cents. [1810]

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 27: Reports of the Field Branch for the Year 1936. Pp. iii+157. (Kuala Lumpur: Department of Agriculture.) 50 cents. [1810]

Rubber Research Institute of Malaya. Pp. 20. Annual Report, 1936. Pp. ii+158. 1 dollar. (Kuala Lumpur: Rubber Research Institute of Malaya.) [1810]

Annals of the Observatory of Lund. No. 6: A Study of Double and Multiple Galaxies, together with inquiries into some General Metagalactic Problems; with an Appendix containing a Catalogue of 827 Double and Multiple Galaxies. By Erik Holmberg. Pp. 160+6 plates. Meddelande från Lunds Astronomiska Observatorium, Ser. 2. Nr. 84 (Historical Notes and Papers, Nr. 8): Über die ersten astronomischen Photographien und ihre Reproduktion: Die Form der Sonnenkorona am 28 Juli 1851. Von Björn Svanouius. Pp. 22. Nr. 87: Formule and Tables for Computation of the Integrated Magnitude of Stars. By W. Gyllenberg. Pp. 22. Nr. 88 (Historical Notes and Papers, Nr. 10): Studies in Spanish Sources, 1. A Medieval Series of Statements on the Colours of the Plants. By Per Collinder. Pp. 16. Nr. 89 (Historical Notes and Papers, Nr. 11): The Arabic Names of the Stars. By Abdel Hamid Mahmoud Samaha. Pp. 8. (Lund: Lunds Astronomiska Observatorium.) [1910]

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 176: Giza 27, a Wilt Immune Strain of Long Staple Cotton. By Dr. Tawfik Fahmy. Pp. ii+13+13 plates. (Cairo: Government Press.) P.T. 4. [2010]

Astrophysica Norvegica. Vol. 2, No. 6: Application of Line Integral Theorems to the Hydrodynamics of Terrestrial and Cosmic Vortices. By V. Bjerknes. Pp. 262-340. (Oslo: Jacob Dybwad.) [2110]

The Rockefeller Foundation: International Health Division. Annual Report, 1936. Pp. v+278. (New York: Rockefeller Foundation.) [2210]

U.S. Department of the Interior: Geological Survey. Bulletin 868-B: Kodiak and Vicinity, Alaska. By Stephen E. Capps. (Mineral Resources of Alaska, 1934.) Pp. iv+93-134. 25 cents. Bulletin 879: Geology and Mineral Resources of the Baker Quadrangle, Oregon. By James Gilluly. Pp. vi+119+3 plates. 65 cents. Professional Paper 186-F: American Cretaceous Ferns of the Genus *Tempekyia*. By Charles B. Read and Roland W. Brown. (Shorter Contributions to General Geology, 1936.) Pp. ii+105-181+plates 27-43. 15 cents. Water-Supply Paper 795: Surface Water Supply of Hawaii, July 1, 1934, to June 30, 1935. Pp. 188. 25 cents. Water-Supply Paper 811: Surface Water Supply of the United States, 1936. Part 11: Pacific Slope Basins in California. Pp. 331. 45 cents. (Washington, D.C.: Government Printing Office.) [2210]

International Hydrographic Bureau. Special Publication No. 23: Limits of Oceans and Seas. Second edition. Pp. 25. (Monaco: International Hydrographic Bureau.) 9 francs. [2310]

Catalogues, etc.

Classified List of Second-hand Scientific Instruments. (No. 118.) Pp. 68. (London: C. Baker.)

The "Newton" and "Wigmore" British Epidiscopes. Pp. 22. The "Ampro" 16mm. Motion Picture Equipment. Pp. 8. The Newton Projection Microscope. Pp. 12. (London: Newton and Co.)

Watson Centenary, 1837-1937. Pp. viii+40. (London: W. Watson and Sons, Ltd.)

The Protexray Tube, Series 3. Pp. 20. (London: Cuthbert Andrews.) Die Askania-Warte. Nr. 7, September-Oktober 1937. Pp. 24. (Berlin-Friedenau: Askania-Werke A.G.)

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3550

SATURDAY, NOVEMBER 13, 1937

Vol. 140

Land Drainage in England and Wales

ONE of the most insistent problems of recent years in the domestic legislation of Great Britain has been that of land drainage. There are many and extensive areas in England and Wales where efficient drainage is a vital necessity to the safety, health and welfare of the inhabitants. Inundations which have afflicted such districts in the past, and even now, in spite of definitely organized preventive measures, can still cause widespread devastation with loss of life and property and possible epidemics of disease, have been a source of constant and anxious concern to successive Governments. Ultimately, a Royal Commission was appointed to investigate the matter, and in 1927 its report appeared, making a series of recommendations of a striking and drastic character, which, supported by public opinion, were, after full discussion, embodied in the Land Drainage Act, 1930. Since that date, a fundamental and revolutionary change has been taking place in the drainage administration of the country; and an account of the operations and proceedings taken under the Act has recently appeared*.

The main difficulty of the situation prior to the passing of the Act was the existence of a heterogeneous collection of drainage authorities, totalling some 361, with miscellaneous constitutions, powers and jurisdictions. Moreover, these bodies, however active and well-intentioned, were inadequately provided with funds and lacked the necessary resources for coping with conditions which had naturally changed more or less fundamentally with the lapse of a long period of years since they were first instituted. Some of them, notably the so-

called "Commissions of Sewers" (the word "sewer" originally signified an open watercourse), dated back to a very remote epoch, and these were preceded by a body, still legally in existence, "the Lords, Bailiffs and Jurats of Romney Marsh," which has had an effective career of nearly seven hundred years. Commissions of Sewers were first appointed in the fifteenth century, but were placed on a more permanent basis by the Statute of Sewers of Henry VIII's reign (1531). Thereafter, other bodies were created, either by private Act of Parliament *ad hoc*, or arising out of the provisions of local inclosure awards in connexion with the inclosure of common lands, a process which was at its height in the closing years of the eighteenth and early years of the nineteenth century.

Of this complicated and cumbrously ineffective machinery the new Land Drainage Act made a clean sweep, and it repealed all the enactments in regard to flood prevention which had been made through centuries of English history, substituting for them a properly organized and co-ordinated system of administration through authorities designated Catchment Boards, taking their title from the drainage unit adopted by the Royal Commission; namely, the catchment area of each river, which is bounded by the natural watershed or water-parting. These catchment areas vary considerably in character, extent and rateable value. Some areas are largely agricultural, such as the Great Ouse, Rother, Severn, Wye, etc., while others include industrial regions, such as the Yorkshire Ouse, Trent, Mersey and Irwell and the mid-Glamorgan rivers. Another feature of notable contrast is the relative proportion of lowlands and uplands. In the catchment area of the Romney and Denge Marsh Main Drains, the percentage of

*Report of Operations and Proceedings under the Land Drainage Act, 1930, from the passing of that Act (1st August, 1930) to 31st March, 1937. Pp. iv+75. (London: H. M. Stationery Office, 1937.) 1s. 6d. net.

lowlands is 72.75, while in the Bristol Avon area it is only 3.22.

At the outset, the Act scheduled forty-seven catchment areas—not by any means an exhaustive list, but as many as it was considered possible to deal with at the start. Provision was made for additions, and as a result of these and some amalgamations, there were at the date of the report under consideration forty-eight catchment boards in England and Wales.

The responsibilities of catchment boards are not limited to the drainage or discharge of water from their respective areas. In a number of cases they have the contingent duty of protecting the low-lying marshlands on the sea or estuary frontage from tidal flooding. Thus, in the case of the Essex Rivers Catchment Area, there are, in addition to a length of 380 miles of main river, no fewer than 320 miles of sea or estuary embankment and defences along the north bank of the Thames from the outskirts of London to Dovercourt, and these need constant supervision and repair.

The term 'main river' requires explanation. It is rather difficult to define with exactitude, though the meaning is fairly obvious. But, for the purposes of the Act, the signification has to be a little elastic. The 'main river' may include more than one channel, and, in fact, consist of several independent streams. It has not been altogether easy in some cases to decide where the main river or main channel should end, or what tributaries should be included.

The existence of tributaries and auxiliary streams has given rise to the formation, under the Act, of internal drainage boards, with duties subordinate to those of the catchment boards. Internal drainage boards can be formed for areas "capable of deriving benefit or escaping danger as a result of drainage operations," so that, in certain cases, a drainage district may exist where there is no catchment area.

The financial depression which set in almost immediately after the passing of the Act hampered, to no small extent, the initiation of important schemes of flood protection works, though a little was done where the need was urgent and perhaps desperate. Prior to March 31, 1934, only ten schemes, totalling nearly £300,000, were approved for the purpose of receiving grants out of monies provided by Parliament towards the expenditure incurred by catchment boards in respect of the improvement of existing works or

the construction of new works. Of this amount, £179,000 was urgently required for sea defences in Rye Bay and north Norfolk. In the former locality, the sea actually breached the defences in November 1930, washed away a number of bungalows and left a widening gap in the natural shingle bank, which was the only defence at that point. When the financial situation eased, as it did after April 1934, fuller advantage was taken of Government assistance, and greater facilities were afforded for dealing with improvement schemes of a general character. Up to March 31 last, seventy-one such schemes had been approved, between fifty and sixty of which are still in course of execution, at an estimated outlay of upwards of six millions sterling.

Attention may appropriately be directed to a feature of the functions of catchment boards having an important bearing on a subject which has often been mentioned in these columns. We have in the past pointed out repeatedly how essential it is in the general interests of the country to institute an effective national survey covering all available water resources. After considerable pressure had been brought to bear on the Government by the British Association, jointly with the Institution of Civil Engineers, a Survey was set up a couple of years ago under the auspices of the Ministry of Health, and two annual reports of its activities have already been issued. Whatever misgivings we may have felt about the limitations apparently imposed on the Survey by its association with a department which cannot be said to be interested in the industrial and commercial use of water, the fact remains that, at present, it is the only organization existing for the purpose.

The Survey, however, cannot carry out single-handed all the operations which it is desirable should be covered, and it will have to rely very largely on the co-operation of external organizations. The catchment boards, with their control over the main rivers in their respective areas, can make a very effective contribution to the data necessary for the Survey, by undertaking a comprehensive study of their rivers, and by installing an adequate number of gauges to record the daily flow, so as to determine the run-off under varying conditions corresponding to the incidence of the local rainfall. This is a very important matter, and we are glad to see—even if only in the final sentence of the report—that attention is directed to it in the account of work being done under the Land Drainage Act.

The British Polar Year Expedition to Fort Rae

British Polar Year Expedition, Fort Rae, N.W. Canada, 1932-33

Vol. 1: Discussion of Results; Meteorology, Terrestrial Magnetism and Aurora, Atmospheric Electricity. Pp. xv + 336 + 5 plates. 21s. net.
Vol. 2: Tables; Meteorology, Terrestrial Magnetism, Atmospheric Electricity. Pp. ix + 228. 15s. net. (Published under the direction of the British National Committee for the Polar Year, The Royal Society, Burlington House, London.) (London: Percy Lund, Humphries and Co., Ltd., 1937.)

THE great scientific enterprise of the Second International Polar Year, 1932-33, is now bearing fruit in the publication, by the various co-operating nations, of the reports of their work. It will be remembered that the enterprise was a repetition and extension of the work of the First Polar Year, 1882-83, its main object being to obtain geophysical observations of various kinds at a number of high-latitude stations (mainly temporary) during a complete year; an associated programme of intensified observations in middle and low latitudes was also carried out during the same period.

After the jubilee of the first polar year had been adopted as a suitable date for the project, and while plans were being made, the great economic crisis occurred. Nevertheless, largely through the enthusiasm and energy of Dr. La Cour, president of the International Polar Year Commission, the project was carried through with great success. As regards the British participation, H.M. Government, through the Air Ministry, placed £10,000 at the disposal of the Royal Society for the purpose; this fund was administered by the British National Committee for the Polar Year, of which Sir Henry Lyons and Sir George Simpson were respectively president and secretary.

The British National Committee devoted the major part of its funds to the re-establishment of a station for comprehensive meteorological, magnetic, atmospheric electrical and auroral observations at Fort Rae, on the Great Slave Lake, Canada, where in 1882-83 the joint British and Canadian expedition had had its base. During the Second Polar Year the Canadian Government established its own very valuable Polar Year station at Chesterfield. The report of this second Fort Rae expedition has recently been issued; though it is not the first of the national Polar Year reports to appear, it is one of the most

complete. A few months before, the Royal Society had published in its *Philosophical Transactions* the report of another enterprise subsidized by the British Polar Year Committee, namely, the expedition for radio exploration of the ionosphere at Tromsø, organized mainly by Mr. R. A. Watson Watt and Prof. E. V. Appleton.

The Fort Rae expedition was led by Dr. J. M. Stagg, who made a preparatory visit to Fort Rae in 1931. He was assisted, in 1932-33, by four specialist scientific officers and a steward-mechanic (Messrs. Morgans, Sheppard, Grinstead, Stephenson and Kennedy). Of the six members of the expedition, all but one (Stephenson) were seconded by or drawn from the Meteorological Service, which in this and many other ways gave invaluable support to the expedition. The first Fort Rae expedition had been led by Captain (later Colonel) Dawson, who lived to see the start, though not the return, of the second expedition; its members, like its leader, had been drawn from the army, and military discipline was observed on the expedition. The second expedition, more specialist in character, worked under freer conditions with not less care, patience and success.

The journey to Fort Rae in 1882-83 was arduous and adventurous. Even in 1932 the outward journey took a month, the last part being by boats with a 16-mile land portage. The cost of transport of the five hundred cases of equipment and stores taken by the expedition from England to Fort Rae was still high—nearly a shilling a pound. It may incidentally be noted that despite the prevailing financial stringency, more than fifty firms had made generous gifts of food supplies, clothing and instrumental equipment to the expedition.

Up to 1931, Fort Rae had remained one of the most isolated trading posts of the Hudson's Bay Company, but then a reputedly rich discovery of gold and pitch-blende ores to the north of Fort Rae led to a rush of prospectors, which continued during 1932-33. An air service to the mining camps was organized, and Fort Rae was used as a fuelling station; this enabled the Fort Rae expedition in 1933 to return by aeroplane to the railway at Edmonton, 1,000 miles away. A general narrative of the expedition is given by Dr. Stagg in the introduction to the report; it is graphic and fascinating, and happily does not omit reference to some of the lighter incidents that occasionally enlivened the very full and arduous labours of the party.

The original site of Fort Rae had been abandoned since 1882-83, and the expedition made its headquarters at the new settlement, about fifteen miles away. The old site was, however, intermittently occupied by a section of the expedition, as a sub-station for magnetic observations and for taking auroral photographs simultaneously at the two sites. A telephone line was laid to connect the old and new Fort Rae; the line was slung partly from trees on the lake shore, but mainly on posts cut from similar trees, let into holes cut in the ice of the lake after this had frozen early in October. Had the line not been raised well above the snow-covered ice, it would soon have been severed by the passage of dog sleighs on the winter trails of the Indians.

Space does not permit a detailed description of the many kinds of work undertaken by the expedition, or of the difficulties and accidents besetting such work in the circumstances of Fort Rae. But mention may be made of the dispatch into the stratosphere of twenty-eight balloons carrying meteorographs, designed to register meteorological conditions during their passage through the troposphere and lower stratosphere. One great difficulty in this work was the low chance of recovery of the meteorographs in the difficult and almost uninhabited region round Fort Rae. To increase the chance of discovery of the fallen instruments by Indians on their trapping trails, a brilliantly coloured ribbon, $\frac{1}{4}$ - $\frac{1}{2}$ mile long, was attached to each meteorograph. Actually only two were found and returned, each with satisfactory records: it may be hoped that others may yet become available in years to come.

The report now published consists of two volumes. The basic data obtained are presented in 287 detailed tables, forming vol. 2; 159 of these are meteorological, 111 geomagnetic, and 17 refer to atmospheric electricity. Their choice and arrangement follow lines drawn up by the Publica-

tions Sub-Committee of the International Polar Year Commission to facilitate comparisons between the results of different national expeditions. The International Commission has also made reduced copies of all the photographic magnetic records on Leica film, for the use of investigators who need such complete material; this applies to Fort Rae and most of the other Polar Year stations.

The first and larger volume is devoted to the discussion of the data set out in vol. 2. The parts relating to geomagnetism (including auroras), meteorology, and atmospheric electricity are respectively due to Messrs. Stagg, Morgans and Sheppard, and occupy approximately 180, 110 and 25 pages. A future publication on the photographic auroral work of the expedition, not discussed in the present volume, is referred to in the introduction.

Of the three discussions in vol. 1, it may in general be said that they maintain the high standard set by the British Meteorological Office in its *Observatories Yearbook*, and are worthy of the fine observations on which they rest. It is specially satisfactory that the discussion has been and could properly be undertaken by those who, having made them, best know their errors and their excellences.

Over many years, the magnetic records of a series of British antarctic expeditions were entrusted for discussion to the late Dr. C. Chree, whose temperament and expert knowledge made him exceptionally suited for this important task. Dr. Chree is no more, but happily the mantle of Elijah has fallen on Elisha, and in the present discussion Dr. Stagg, a former collaborator and part disciple of Dr. Chree, has fully risen to the important opportunity it afforded. His work as leader, as chief scientific officer in carrying out the observing programme, and as author of the largest and most difficult section of the report, is of outstanding merit.

S. C.

Indirect Rule in Nigeria

Law and Authority in a Nigerian Tribe:
a Study in Indirect Rule. By Dr. C. K. Meek.
Pp. xvi + 372. (London, New York and Toronto:
Oxford University Press, 1937.) 17s. 6d. net.

DR. C. K. MEEK'S investigations into Nigerian anthropology have for long been recognized as standard works of great value, owing to the eminently sound, practical, common-sense point of view with which he discusses subjects which are too often made the pegs upon which to hang fantastic or doubtful speculative theory. This new

book of his does not depart from that high standard which his other works have led us to expect.

We have all come to regard northern Nigeria as so much the home and classic example of 'indirect rule' that it is of especial interest to read, in this scholarly work, of the application—and misapplication—of the principles involved in this great ideal, to the so-called 'pagan' areas in the south.

The writer of this notice has for long pointed out that one of the dangers which still menaces the successful application of indirect rule lies in

the misconception which still exists in many quarters regarding the true status and functions of *soi-disant* African 'kings' or native rulers, and of the democratic basis which underlies every form of indigenous African Government, however apparently autocratic it may seem. To the West African, democracy implies that the affairs of the State must rest, not in the hands of the few, but in the keeping of the many.

In this book, Dr. Meek—besides giving us a very full and interesting account of Ibo customs and beliefs—tells us calmly of the happenings that led to, and resulted in, 'the women's riots' of November 1929. These disturbances developed from an almost total disregard of certain fundamentals, and were the sorry penalty the Nigerian administration had to pay for their misconception of the Africans' idea as to what forms the elementary basis of their social law and order.

The principal native executive officers, in the persons of the chiefs—so dearly beloved by a certain type of administrative officer—had gradually assumed the titles and functions of highly despotic rulers. The efficient and quite intricate decentralized system of government, which had once upon a time enlisted the co-operation of private, family, kindred and tribal groups in the administration of law and order, had gradually come to be ignored or brushed aside. The kind of indirect rule which Mary Kingsley, half a century before, had declared to be a parody, became the recognized form of administration.

African women, as once again Miss Kingsley could have foretold, rose—very literally—in arms. It was, indeed, a sorry tale, but at any rate the story need never be repeated if those who have the welfare of African peoples in their hands will only study carefully such a work as this.

Dr. Meek's advocacy for the inclusion of young educated Africans, that is, those educated on European standards, is also one of very real necessity if this great experiment in trusteeship is to have a full chance of success. After all, it is in the hands of such that the future of black Africa will surely lie.

The reviewer of this excellent book has only one minor complaint to make. It seems strange to note the complete absence, in a volume dealing with Nigeria and indirect rule, of even the name of the founder of this African Empire and of this African ideal—Sir George Goldie. Yet, long before the phrases 'dual mandate' and 'indirect rule' were ever coined, he had laid down the foundations of both, and formulated his policy, in words which cannot be bettered, even to-day.

"If the welfare of the native races is to be considered, if dangerous revolts are to be obviated, the general policy of ruling on African principles through native rulers must be followed. . . ."

The book is printed and produced as befits the traditions of the Oxford University Press.

R. S. RATTRAY.

Catalytic Reactions

(1) The Catalytic Action of Surfaces

By J. E. Nyrop. Second edition. Pp. 102. (Copenhagen: Levin and Munksgaard; London: Williams and Norgate, Ltd. 1937). 7s. net.

(2) Katalytische Umsetzungen in homogenen und enzymatischen Systemen

Von W. Frankenburger. Pp. xi + 444. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 36 gold marks.

IT is probably true to say that the problem of the mechanism of heterogeneous catalysis has been and still is one of the most hotly debated topics in physical chemistry. A wealth of papers and books advocate rival theories, each supported by an abundance of experimental fact which can scarcely be discussed critically and impartially by one author.

(1) In the book under review, a rather novel viewpoint is adopted in order to attempt to bring heterogeneous reactions within the confines of one co-ordinating theory. Dr. Nyrop makes two

postulates in his theory: (a) adsorption is accompanied by ionization of the adsorbed molecules, the latter being thus held to the surface by ionic forces; (b) the lower the ionization potential of the impinging molecule, the higher its degree of adsorption. These postulates immediately imply that catalysis will not be observed unless the surface is capable of ionizing the interacting molecules. Furthermore, if two different kinds of molecules interact, it is necessary to ionize both.

Support for these views is initially mainly derived from experiments on the activation of molecules by low-voltage electrons in which ionization invariably precedes reaction. The question as to whether this idea can be applied *mutatis mutandis* to catalytic surfaces is one best settled by the reader of the book. There can be no doubt that some of the kinetics of heterogeneous reactions, such as the inhibiting effect of reactants and of products, may be accounted for by a consideration of the relative ionization potentials of such molecules. But whether surfaces normally

employed in catalysis are capable of effecting ionization of molecules requiring some 10–15 volts, when the work function of the surface in question may be less than half this value, is rather a moot point upon which judgment must be reserved. None the less, this monograph is a bold attempt to break away from the conventional and explore other methods for the elucidation of the intricacies of heterogeneous catalysis.

(2) While heterogeneous catalysis is at present treading a somewhat thorny path, homogeneous catalysis progresses in a more deliberate and systematic manner. Dr. Frankenburger's book in its thoroughness and completeness is the best proof of the latter contention. In fact, it might fairly be asked if this subject comprises the whole of that part of chemistry dealing with reactions with the exception of heterogeneous phenomena in the gas phase.

The book is naturally divided into three sections, preceded by an introduction to chemical dynamics, which is given in a straightforward manner without digressing too far into rigorous methods. This is the best compromise since, for the understanding of the remainder of the book, a detailed treatment is not necessary and indeed might prove a 'potential barrier' over which many readers would be disinclined to pass. The first section comprises an

account of well-known homogeneous catalytic reactions such as the effect of moisture on chemical change, a brief but sufficient description of a number of typical chain reactions, together with a discussion of simple gas-phase bimolecular reactions. In the second section, acid and base catalysis is given an adequate treatment. Included in this section is an account of oxidation in the liquid phase, with a return to the chain treatment of these processes. The section is brought to a close by a discussion of some reactions in organic chemistry, such as condensation, dehydration, etc. Finally, the last section treats heterogeneous catalysis in the liquid phase, namely, enzymatic reactions. A few pages are also devoted to reaction induced by colloidal metals.

The field thus covered is so large that exhaustive treatment of every aspect of the subject cannot be expected. The great merit of the book, however, lies, as it should, in the ease with which the reader may consult and understand any small portion without having to read the preceding hundred pages.

After perusal of these books the reader has every reason to inquire of the chemist: Are all chemical reactions catalytic? He would be a bold person who would answer in the negative.

H. W. MELVILLE.

Measurement of Radiant Energy

Measurement of Radiant Energy

Edited by W. E. Forsythe. Contributors:—Charles G. Abbot, Elliot Q. Adams, Loyal B. Aldrich, Ernest F. Barker, Bentley T. Barnes, William W. Coblentz, Paul H. Dike, Gustave Fassin, William E. Forsythe, Kasson S. Gibson, George R. Harrison, Herbert E. Ives, Loyd A. Jones, Lewis R. Koller, Henry F. Kurtz, A. Herman Pfund, Bartholomew J. Spence, Donald C. Stockbarger, A. Hadley Taylor, Willibald Weniger, Archie G. Worthing. Prepared under the direction of A. C. Hardy, Herbert E. Ives, and W. E. Forsythe. Pp. xiv + 452. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30s.

THE successive chapters of this book deal with fundamental ideas; sources of radiation; principles of analysis; spectrometers, general and particular; thermal, photo-electric and photographic measurement; densitometers; galvanometers; spectrophotometry; pyrometry; photometry; special problems. Many of these topics are each the subject of treatises as long as this book; accordingly it was necessary for the

editorial committee to decide exactly what was the gap in the literature that they proposed to fill.

In my opinion they have not performed this duty satisfactorily, and for this reason the book, in spite of excellence in some details, falls much below the high standard which the publishers have set themselves in other books of the same series. The editors might have aimed at an encyclopædia, mentioning every problem that might possibly arise in their field and indicating where a complete discussion of it was to be found. They might have aimed at an original work, discussing only problems that have been unduly neglected. Or they might have aimed at criticism, selecting from the vast amount of recorded knowledge that which is of special and permanent value. Actually they have confused all three aims. A few topics receive more than their proper share of space, because something new has to be said of them. Although every topic appears to be mentioned, the text, combined with the references, is sometimes quite inadequate to convey important information concerning them (luminescence, heterochromatic photometry, 'barrier-layer' photo-cells are examples). While some

sections are admirably critical, others are mere compilations of quite elementary facts and ideas.

The best sections are undoubtedly the most critical. Chapters iv (spectrometric instruments and their adjustment), vi (radiometry), x (galvanometers), xii (pyrometry) appear to me admirable; if the other chapters had shown equal knowledge and insight, the book, though it would have been a mere set of essays on slightly related subjects, might have been of great value. Chapter viii (photographic measurement) approaches the encyclopædic ideal, but is open to the objection that other works of greater length discuss the same matter with equal skill and in necessarily greater

detail. Chapter i (fundamental ideas) might have been abbreviated to a simple list of formulæ; on the other hand, not even Messrs. Forsythe and Ives can treat photometry (chapter xiii) adequately in 18 pages. The remaining chapters seem to me satisfactory so far as they go, but undistinguished; it is difficult to guess to whom precisely they are addressed.

These are, however, all matters of opinion; the editor's and authors' names are a sufficient guarantee that there will be no serious errors; I can only hope that others will find in this work a higher value than I have been able to put upon it.

NORMAN R. CAMPBELL.

Nutrition and Dietetics

(1) *The Little Things in Life :*

the Vitamins, Hormones and other Minute Essentials for Health. By Prof. Barnett Sure. Pp. xii + 340. (New York and London: D. Appleton-Century Co., Inc., 1937.) 8s. 6d. net.

(2) *Elements of Foods and Nutrition*

By Mary T. Dowd and Prof. Alberta Dent. Pp. xiii + 279. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 8s. 6d. net.

(3) *Dietetics Simplified :*

the Use of Foods in Health and Disease. By Prof. L. Jean Bogert. With Laboratory Section by Mame T. Porter. Pp. ix + 637. (New York: The Macmillan Co., 1937.) 12s. 6d. net.

THIS series of American books dealing with nutrition illustrates some of the methods by which the results of scientific inquiry may be made generally available for the benefit of a community.

(1) The method adopted by Prof. Sure is to present the more dramatic aspects of the subject in a form which may appeal to the intelligent layman. In "The Little Things of Life" he describes the part played by vitamins, mineral elements and hormones in the regulation of living processes, his main theme being the influence of these chemical substances on nutrition and therefore on health. Though written in "non-technical language", the account he gives is more detailed than might be expected from the title. Laymen introduced for the first time to the new knowledge of nutrition might digest more easily a plainer story, in which less attention is given to the chronological sequence of individual discoveries. The general public is usually content with getting some grasp of the main significance of scientific discoveries and is not deeply interested in settling questions of priority.

Nevertheless, the persistent reader will obtain much interesting information from this volume, and he should be duly impressed with the way in which recent biochemical work is being applied to the prevention and treatment of human disease.

(2) The little book by Dowd and Dent is avowedly a text-book for use in schools, and fulfils well its purpose of providing a basis for the teaching of good food habits to children in their more advanced forms. The subjects dealt with include not only the physical and chemical properties of the individual components of food and their function in nutrition, but also the principles of food selection for the purpose of securing good nutrition, with due regard to the cost of living. A useful chapter is added on common food fallacies, in which the fantastic views of certain types of food faddist are exposed. Numerous illustrations are included.

(3) The last of these books, "Dietetics Simplified," is again a text-book, but with an appeal to a more specialized audience—students of domestic science, hospital dietitians, nurses, medical students and perhaps intelligent housewives. The first two sections contain a clear and practical exposition of the principles of nutrition as applied to the normal human being. These are followed by a section devoted to the use of diet as a therapeutic agent in disease. It is shown how the normal good diet may be modified to suit the particular requirements of the subjects of disease. The reasons for advising the suggested modifications are given and these are in accord with current medical and scientific thought. The last third of the book is a practical manual of menu-planning and cookery. All those whose work includes the planning of diets for promoting health and treating established disease will find in this volume a mine of valuable information.

A History of Psychology in Autobiography

(International University Series in Psychology.) Vol. 3. By James Rowland Angell, Frederic Charles Bartlett, Madison Bentley, Harvey A. Carr, Sante De Sanctis, Joseph Fröbes, O. Klemm, Karl Marbe, Charles Samuel Myers, E. W. Scripture, Edward Lee Thorndike, John Broadus Watson, Wilhelm Wirth. Edited by Carl Murchison. Pp. xvii+327. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1936.) 22s. 6d. net.

THE thirteen American, English, German and Italian psychologists whose autobiographies appear in this volume were selected in 1928, like those in the two previous volumes of the series, by a committee of five members of whom the editor was one. The idea of making eminent representatives of one branch of science tell the story of their intellectual development is not a new one, and was probably suggested in this instance by the series edited about fifteen years ago by Prof. L. G. Grote of Halle, in which the history of medicine of the present time is related in an autobiographical form.

Undoubtedly the most vivid autobiography in the present volume is that of the late versatile Prof. Sante De Sanctis, who although he claimed to be "above all and essentially a physician", was also the author of important work on psychology in relation to children, religion, criminology and dreams. In addition to the lively narratives of F. C. Bartlett and C. S. Myers, reference should be made to the contributions of Harvey A. Carr, notable for his work on the psychology of animals, O. Klemm, the author of a history of psychology and works on experimental and racial psychology, E. W. Scripture, the pioneer in experimental phonetics and speech neurology and E. L. Thorndike, well known for his work on child study, educational psychology and the measurement of intelligence. Several contributors discuss the educational aspects of psychology, especially F. C. Bartlett, who maintains that all teaching in psychology should be as informal as possible, and emphasizes the importance of a good practical training in physiology, biology and the elements of physical science as well as some instruction in philosophy and logic. Fröbes stresses the value of his five years' work as a teacher in mathematics, physics and chemistry in relation to his subsequent career, and Angell modestly declares that his influence on the course of psychological development was due less to his own investigations than to his students, who afterwards had highly successful careers.

The usefulness of the work would have been considerably increased if a bibliography had been attached to each autobiography.

Glastechnische Fabrikationsfehler

Von Dr. Hans Jebson-Marwedel. Herausgegeben mit Unterstützung der Deutschen Glastechnischen Gesellschaft E.V. Pp. x+295. (Berlin: Julius Springer, 1936.) 48.80 gold marks.

MOST glass technologists will be familiar with Dr. Peddle's book "Defects in Glass", published some ten years ago, and will remember how this systematic

exposition of the faults in glass-making was welcomed. They will, if they read German, also be familiar with Dr. Jebson-Marwedel's papers dealing with the melting and refining of glass, devitrification and kindred problems.

In the book now under review much of this work reappears in a connected form. The pace of the advance in glass technology is well illustrated by the difference in scope of the English and German works and by the wealth of documentation in the present one. Whilst in the latter Dr. Jebson-Marwedel draws heavily on his own work, he does not rely entirely on it by any means, for of 639 references which are scattered throughout the book at the ends of the various sections, his name only appears in something less than ten per cent. The value of the work is enhanced by the lavish use of illustrations, both photographic and diagrammatic. The 295 pages contain in all 441 figures, and one colour plate is reproduced from the *Glastechnische Berichte* to show the effect of the 'oxygen pressure' in the melt on the colour of iron-containing glasses. Even those whose knowledge of German is rudimentary may learn much from the figures. Special mention may perhaps be made of the 'three dimensional' one illustrating the effect of diameter and temperature on the rate of rise of a bubble through a glass melt, and of the one showing the effect of furnace atmosphere and temperature on the residual SO_2 in the melt.

The setting out is clear, the type and reproduction of the figures excellent, and, save for a few understandable mistakes in names foreign to the proof reader, typographical errors are remarkably few for a first edition.

Altogether, the volume represents a notable contribution to the glass technologist's reference library and, though its price will probably prevent many from putting it there, it cannot be regarded as unduly expensive.

M. PARKIN.

Field Tests for Minerals

By E. H. Davison. Pp. viii+60+12 plates. (London: Chapman and Hall, Ltd., 1937.) 7s. 6d. net.

IN spite of the existence of other books of this type, designed as ready aids to mineral determination by relatively simple methods, Mr. Davison may be congratulated on producing a comprehensive summary of field tests in a form convenient for the traveller whether in settled or unsettled lands, at a relatively low price. The book, as it should be, is practical, and includes tests for all the minerals the student or prospector is likely to find. There is little room for criticism, but it might perhaps be possible to include in future editions black-and-white sketches of the results of microchemical tests, such as the "colourless highly refracting plates" characteristic of antimony; to many such would be more useful than some of the illustrations given of hand specimens. For one who has to 'travel light' in places where even the simplest apparatus or common reagents are unobtainable, a list of indispensable articles might save both time and inconvenience.

The book will prove useful to students, whether beginners or advanced.

J. P.

Die Fernrohre und Entfernungsmesser

Von Dr. Albert König. Zweite Auflage. Pp. v+242. (Berlin: Julius Springer, 1937.) 24 gold marks. SHORTLY after the Great War, Dr. König, whose association with Messrs. Carl Zeiss of Jena eminently fitted him for the task, published his book on the telescope and range-finder. It dealt particularly with the more important fighting service optical instruments such as binoculars, sighting telescopes, submarine periscopes and range-finders, with the intricacies of which so many people through necessity had become familiar.

The second edition, in comparison with the first, which appeared at a time of great depression, is an excellent production, well illustrated and printed. It is stated in the preface, which modestly describes the book as a "Büchlein", that about half the original illustrations have been discarded and replaced by twice the number of new ones. The text has been correspondingly revised not only in the practical but also in the theoretical portions. A new section has been devoted to the important recent developments of anti-aircraft height- and range-finders of various types.

Many readers will find the historical descriptions of interest and particularly the additional chapter at the end which summarizes the history of the telescope from Lipperhey to Porro. Its invention has been attributed to Lipperhey in preference to Janssen, to whom Borel accorded the honour.

The use of abstruse mathematics has been avoided to an even greater extent than in the first edition, but the usefulness of the book to the student has not been prejudiced thereby. This excellent edition embodies so much new material that it may be read with advantage by those already familiar with the contents of the original work. J. W. F.

Zusammenhänge zwischen physikalischen Eigenschaften und chemischer Konstitution

Von Prof. Dr. Robert Kramann. Mitbearbeitet von Dr. Max Pestemer. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 41.) Pp. xvi+225. (Dresden und Leipzig: Theodor Steinkopff, 1937.) 16 gold marks.

It is characteristic of the present state of natural science that books appear with increasing frequency dealing with borderland subjects between physics and chemistry. This is all to the good, since boundaries have been needlessly rigid in the past.

In the book before us, it is natural that the molecule forms the basis of discussion, but stress is laid upon the relation between physical properties of the molecule as such, and the constitutional effects which derive from them. A particularly welcome chapter is that concerned with the forces of cohesion and surface potential, which concludes with some useful information about melting points. The interest of the volume is that the authors have produced a compact treatise upon chemical physics, rather than upon the conventional physical chemistry. The diagrams are too cramped to be very helpful, but the text is clear and concise. F. I. G. RAWLINS.

Lectures on College Algebra:

a Text Book for the use of Intermediate Students of Indian Universities. By S. B. Dandekar. Pp. xii+402. (Indore City: Vinayak and Co., 1936.) 3 rupees; 5s.

THE author of this very interesting volume claims to present a course in algebra, suitable for the use of intermediate students of Indian universities, in a manner quite different from that given in other books. An attempt is made—with commendable success—to deal with fundamental principles and methods in a simple, logical and connected form which will at once arouse the student's interest in, and enthusiasm for, the subject.

Beginning with preliminary notions, the topics considered, taken in order, include surds, theory of indices, ratio, proportion, variation, complex quantities, theory of quadratics, the progressions with applications to interest, annuities and scales of notation, logarithms, permutations and combinations, the binomial and exponential theorems, partial fractions and determinants. There is no doubt that it would be difficult to find any other book that deals with so comprehensive a course in such an order. It is certainly a long way from preliminary notions to complex quantities; yet the latter form the subject matter of chapter iii. There are, however, alternative courses of reading suggested to suit the particular needs of different types of student.

The whole treatment, whilst being very succinct, is quite sound, and the style of presentation one which compels interest from the beginning.

F. G. W. B.

Volumetric Analysis

By A. J. Mee. Pp. vii+223. (London: William Heinemann, Ltd., 1937.) 7s. 6d.

THIS useful text-book is meant primarily to cover the course of volumetric analysis necessary for the various school and university examinations. It deals especially with the growing tendency on the part of examiners to set questions dealing with the application of titrimetric methods to the solution of practical chemical problems. While this does not convert the work into a treatise suitable for the industrial chemist, it certainly covers a surprisingly large field and will be found of value not only to students but also to many others who make use of such methods of analysis. The subject-matter is quite up to date, and contains sections dealing with the use of ceric sulphate, titanous sulphate and chloride, potassium bromate with special reference to the evaluation of 8-hydroxyquinoline in metal complexes by means of bromate-bromide mixture and, in addition, there are given numerous interesting precipitation methods.

The text is set out mainly in the form of exercises which the student is expected to carry out, these being carefully and lucidly described and adequately explained. Additional exercises are given at the end of each chapter and there are also included a large number of problems. Two short appendixes deal respectively with automatic burettes and pipettes and with mixed and universal indicators, while a third appendix contains a list of materials required in working out the various problems. G. R. D.

Chemotherapy of Amœbicides*

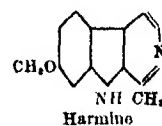
By Dr. F. L. Pyman, F.R.S.

RESEARCH on amœbicides was greatly facilitated by the technique developed by Dobell and Laidlaw (1926), and Laidlaw, Dobell and Bishop (1928) for testing amœbicides *in vitro*. Emetine has for long been the principal drug used in the treatment of amœbic dysentery, but it has some undesirable by-effects, amongst others a nauseating effect. In a search for substances having the amœbicidal action of emetine without its nauseating effect, a number of alkaloids very closely related to emetine in chemical structure were made at an earlier period. When tested by Dale and Dobell (1917), by an early laboratory method, several of them, *O*-methylpsychotrine (a substance which differs from emetine structurally only in containing two hydrogen atoms fewer) and *N*-methylemetine, for example, were found to be more toxic to *Entamoeba histolytica* than emetine itself. Clinical trials of *O*-methylpsychotrine (Jepps and Meakins, 1917) and *N*-methylemetine, however (Low, 1915; Wenyon and O'Connor, 1917), showed them to be of little or no value in the treatment of amœbic dysentery.

The method of Dobell and Laidlaw, however, depending on the cultivation of amœbæ in a medium consisting partly of solid (inspissated fresh horse serum) and partly of liquid (egg-white diluted with Ringer's fluid) with a little starch, gave results which fell into line with the clinical results. Emetine was found to be fifty times as toxic to amœbæ *in vitro* as *N*-methylemetine, *iso*-emetine, and *O*-methylpsychotrine, which are clinically inactive. Later, Laidlaw, Dobell and Bishop described a simpler medium, consisting of 1 part of sterile horse serum, 8 parts of Ringer's fluid with a small quantity of sterile solid rice-starch, disodium hydrogen phosphate being added as a buffer. In this medium they found that the amœbæ were destroyed in four days by emetine 1 in 5,000,000, provided that the medium did not become too acid. We have made use of this method in the work which I am about to describe.

A homologous series of normal alkylharmols, from methylharmol (harmine) up to dodecylharmol, was examined, and it was found that both bactericidal and amœbicidal activity increased, on ascending the homologous series, up to a point and then started to fall. Peaks of bactericidal activity were reached at butyl for *B. typhosus* and at amyl

for *S. aureus*, whilst the peak of amœbicidal activity was reached at *O*-*n*-nonylharmol.

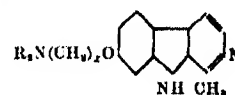


Compound.	R.W. Coefficients.		Minimum concentration lethal to <i>Entamoeba histolytica</i> .
	<i>B. typhosus</i> .	<i>S. aureus</i> .	
Harmol	1	---	1 in 40,000 to 1 in 80,000
Harmine	< 1	---	
<i>O</i> -ethylharmol	25	---	1 in 80,000
<i>O</i> - <i>n</i> -propylharmol	225	75	1 in 80,000 to 1 in 120,000
<i>O</i> - <i>n</i> -butylharmol	350-400	150	1 in 20,000 to 1 in 80,000
<i>O</i> - <i>n</i> -amylharmol	350	250-300	1 in 100,000 to 1 in 200,000
<i>O</i> - <i>n</i> -hexylharmol	50	45-50	1 in 100,000 to 1 in 200,000
<i>O</i> - <i>n</i> -heptylharmol	30-35	45-50	1 in 200,000
<i>O</i> - <i>n</i> -octylharmol	15	35-40	1 in 200,000 to 1 in 300,000
<i>O</i> - <i>n</i> -nonylharmol	10-15	15	1 in 200,000 to 1 in 500,000
<i>O</i> - <i>n</i> -decylharmol	10	--	1 in 100,000
<i>O</i> - <i>n</i> -dodecylharmol	5	--	1 in 100,000 not lethal

The salts of this and other high members of the series were very sparingly soluble in water, and consequently a further series of compounds was prepared, with the hope of obtaining more readily soluble compounds.

The method adopted was to add a further salt-forming group to the molecule in the form of a terminal dialkylamino-group, such as is employed in the antimalarials, plasmoquine and atabrin.

In this way there was made a series of derivatives of harmol having the general formula given below, the salts of which proved, as had been expected, to be readily soluble in water.



The size of both R (the N-alkyl groups) and *x* the number of carbon atoms in the chain separating N from O was varied, and the results may be illustrated by reference to a series in which the decyl group (*x* = 10) was a common factor, whilst the dialkylamino group was varied.

Compound.	Minimum concentration lethal to <i>Entamoeba histolytica</i> .	
<i>O</i> - <i>n</i> -dimethylaminodecylharmol	1 in 300,000 to 1 in 500,000	
<i>O</i> - <i>n</i> -diethylaminodecylharmol	1 in 200,000 to 1 in 500,000	
<i>O</i> - <i>n</i> -di- <i>n</i> -butylaminodecylharmol	1 in 750,000 to 1 in 2,000,000	
<i>O</i> - <i>n</i> -di- <i>n</i> -amylaminodecylharmol	1 in 750,000 to 1 in 3,000,000	
<i>O</i> - <i>n</i> -di- <i>n</i> -butylaminoundecylharmol	1 in 750,000 to 1 in 4,000,000	
<i>O</i> - <i>n</i> -nonylharmol	1 in 200,000 to 1 in 500,000	
Emetine hydrochloride	1 in 2,000,000 to 1 in 10,000,000	

It was thus found that the activity of members at the peak of the series, such as *O*-*n*-di-*n*-butylaminoundecylharmol, was many times that of

* From the presidential address entitled "Researches in Chemotherapy" to Section B (Chemistry) of the British Association, delivered at Nottingham on September 2.

O-*n*-nonylharmol, and this fact led us to suspect that the harmol residue might not be an important contributor to the amoebicidal properties of the molecule.

A number of compounds were then prepared in which dibutylaminodecyl (or undecyl) groups were introduced into molecules of varying structures. The last columns in the following tables show the limits of the range of the minimum concentration found lethal to *Entamoeba histolytica* in three days, under the conditions laid down by Laidlaw, Dobell and Bishop (*loc. cit.*).

Compound.	Minimum concentration lethal to <i>Entamoeba histolytica</i> .
$(C_4H_9)_2N.(CH_2)_{10} \cdot O \cdot \text{[Structure]}$	1 in 750,000 to 1 in 4,000,000
$(C_4H_9)_2N.(CH_2)_{10} \cdot O \cdot \text{[Structure]}$	1 in 100,000
$(C_4H_9)_2N.(CH_2)_{10} \cdot O \cdot CO \cdot CH_3$	1 in 100,000
$(C_4H_9)_2N.(CH_2)_{10} \cdot O \cdot CO \cdot (C_6H_5)$	1 in 100,000
$(C_4H_9)_2N.(CH_2)_{10} \cdot N \cdot (C_6H_5)_2$	1 in 2,000,000

It was thus shown that the attachment of the group $(C_4H_9)_2N.(CH_2)_{10}$ to a simple substituted amino group gave very high efficiency.

A long series of tetraalkyldiamino paraffins of the general formula $NRR'.(CH_2)_n.NRR'$ was then prepared, and the minimum amoebicidal concentration under the optimum conditions for emetine determined.

In the first place, derivatives of heptane and decane were examined; of the heptane series the tetraethyl diamino and tetra-*n*-butyldiamino compounds were prepared and tested. The tetrabutyl member of the series was superior as an amoebicide to the tetraethyl one, but neither showed more than a fraction of the efficiency of the best harmol derivative. More promising results were obtained with the corresponding decane derivatives, and ultimately the efficiency of dibutylaminoundecylharmol was equalled or even, in some of our tests, surpassed.

The following table shows the results of a test in which a number of decane derivatives of the general formula $R_2N.(CH_2)_{10}.NR_2$ were examined simultaneously, so that the 'peak' of the series could be ascertained. This was found at α -tetra-*n*-amyldiaminodecane, which was used as a standard of comparison in later work. For brevity, it is referred to below as T.A.D.D.

Compound.	Minimum concentration lethal to <i>E. histolytica</i> .
α -Decanes	
Tetra- <i>n</i> -propyldiamino	1 in 250,000 not lethal
Tetra- <i>n</i> -butyldiamino	1 in 1,500,000
Tetra- <i>n</i> -amyldiamino	1 in 8,000,000 (or less)
Tetra- <i>n</i> -hexyldiamino	1 in 1,000,000
Tetra- <i>n</i> -heptyldiamino	1 in 250,000 not lethal

A similar test indicated that the corresponding

series of undecane derivatives also showed the peak with the tetraamyldiamino member.

Next, keeping a tetrabutyl or tetraamyl group constant, the hydrocarbon residue was varied. The following table shows the results of two tests on these series of compounds.

Compound.	Minimum concentration lethal to <i>E. histolytica</i> .
Test 1.	
α -Tetra- <i>n</i> -butyldiamino-	
nonane	1 in 800,000
decane	1 in 1,000,000
undecane	1 in 2,000,000
dodecane	1 in 1,500,000
tridecane	1 in 1,000,000
Test 2.	
α -Tetra- <i>n</i> -amyldiamino-	
octane	1 in 400,000
nonane	1 in 1,000,000
decane	1 in 2,000,000
undecane	1 in 1,500,000
dodecane	1 in 200,000

As the results of the foregoing experiments, α -tetra-*n*-amyldiamino-*n*-decane (T.A.D.D.) was selected for further study. The conditions of all the amoebicidal tests described above were those most favourable for emetine, that is, in a faintly alkaline medium. It is well known (Laidlaw and others; Henry and Brown, 1923) that the exceedingly high efficiency of emetine *in vitro*, of the order of 1 in 5,000,000, is only found in alkaline, neutral or only very faintly acid media. Our results afford abundant confirmation of this fact. When endeavouring to assess the value of an amoebicide in the treatment of amoebic dysentery by comparison with emetine *in vitro*, it appears therefore necessary to consider carefully the hydrogen ion concentration likely to be met with in the areas infested with amoebae.

We have been unable to find any reference to the actual hydrogen ion concentration in the amoebic ulcer, but Knowles and others (1923) found that the pH of a number of stools containing motile amoebae averaged 6.22. They also reported the results of experiments on kittens artificially infected with *E. histolytica* in which the colon and rectum of the animals were minced in saline and the hydrogen ion concentration of the suspension determined. The average pH value obtained in these experiments was 6.33, and the livers when similarly treated showed an average pH value of 6.34.

Furthermore, a considerable amount of work has been carried out upon the reaction of living, dead and diseased body cells, and the work of Rohde (1927) and Chambers and others (1927) suggests that the contents of the ulcers may have a hydrogen ion concentration more acid than pH 7.0.

A consideration of these papers suggested that in any comparisons of amoebicides with emetine

in vitro the effect of acidity should be studied, particularly when the amoebicides are to be administered orally, and that tests should be carried out at a pH value of 6.2 or 6.3.

Under these conditions T.A.D.D. is three to five times as efficient as emetine. Moreover, when blood is added to the medium even at pH values otherwise favouring emetine, T.A.D.D. and emetine are of very similar amoebicidal value, the former at times showing a definite superiority.

The toxicity of T.A.D.D. to mice has been compared with that of emetine, with the following results:

	Median Lethal Dose (mgm./gm.)		
	Oral.	Subcut.	Intraven.
α -Tetra- <i>n</i> -amylidiaminodecane dihydrochloride	0.45	0.35	0.04
Emetine dihydrochloride	0.04	0.06	0.018

It has thus only one tenth of the toxicity of emetine when administered orally to mice and one sixth on subcutaneous injection. Its therapeutic index is therefore much more favourable than that of emetine, and it appeared to be an exceptionally promising compound for clinical trial in conditions of ill-health due to infestation with *Entamoeba histolytica*. At this point, it was

recommended to and accepted by the Therapeutic Trials Committee of the Medical Research Council for clinical trial. It was tried clinically by Prof. Warrington Yorke, who has kindly allowed me to state his results. He finds that T.A.D.D. has some action in amoebic dysentery, when administered orally, but is not sufficiently active to be of any real value. Unfortunately, it cannot be given intramuscularly, subcutaneously or intravenously, as it is intensely irritating.

It appears, therefore, that the comparison of the amoebicidal values of emetine and T.A.D.D. with a faintly alkaline medium gives a better indication of their relative clinical value than the comparison in a slightly acid medium. This knowledge will be of value in further work on the subject.

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A New Conception of Supraconductivity*

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5. According to these conceptions, *there cannot exist any magnetic flux 'frozen' in the interior of pure supraconductors*; a permanent flux should only be found confined to the *hollows of supraconducting rings*. The topological connectivity of a supraconductor, therefore, is a property extremely characteristic of its behaviour: the multiplicity of its connectivity, diminished by one, immediately indicates the number of independent conservative quantities, that is, of independent invariant magnetic fluxes.

Actually, however, in the classical experiments of Kamerlingh Onnes, already there have been found magnetic fields 'frozen' in even simply connected supraconductors. It was these permanent fluxes which seemed at that time directly to indicate the elementary phenomenon: an *infinite conductivity*. We, on the contrary, do not consider these experiments as representing the elementary case of the phenomenon, but rather as a relatively complicated affair which can be reduced to a still more elementary phenomenon.

According to our conceptions, we interpret these magnetic fluxes 'frozen' in the interior of the supra-

conductors as follows*: One knows that the presence of a magnetic field exceeding a certain critical value H_T (depending on the temperature T) destroys the supraconductivity. Now it can happen that some magnetic fluxes are confined in certain regions of the metal in such a manner that the critical magnetic field is there exceeded, whereas in the supraconducting regions the supraconductivity is maintained. Thus the appearance of the permanent fluxes should be conditioned by the formation of a complicated structure of the supraconducting and the normal phases in the metal in such a way that the supraconducting regions constitute rings embracing the magnetic fluxes in their non-supraconducting hollows.

6. It is easy to see that, even in very simple experiments, such a *mixed structure of the two phases* must automatically arise. This can be shown by considering, for example, a supraconducting sphere which is brought into a homogeneous magnetic field.

The sphere pushes back the magnetic lines of force and compresses them in the region near the equator. An elementary calculation shows that the intensity of the field immediately on the

*Continued from page 796.

equator (H_e) is one and a half times greater than that (H_∞) at great distance from the sphere :

$$H_e = \frac{3}{2} H_\infty$$

With an external field $H_\infty = 2/3 H_T$, therefore, the field on the equator attains just the critical value H_T , whereas everywhere else it is smaller than H_T . When we now intensify the field a little, the supraconductivity will be destroyed in the sphere immediately behind the equator. But then the magnetic field can enter this region and the magnetic lines of force will be less compressed. As a consequence the magnetic field at the equator will be a little less than H_T , and the supraconducting state will here reappear. If now we intensify the field a little more, the supraconductivity will be destroyed anew immediately behind the equator, whilst the supraconducting layer just formed will move farther into the interior of the sphere.

7. At first sight it seems extraordinarily difficult to make such a microstructure of layers accessible to theoretical treatment. To do this it would be necessary to solve a very complicated boundary problem for which the shape of the boundaries has still to be determined, whilst even their number is not yet known. It is possible, however, to avoid this practically insoluble problem, if one abstains from determining that microstructure in detail and rather restricts oneself to considering the *mean values* of the field strengths taken over this microstructure of the phases. Actually it is these mean values of the fields which are above all the object of the experimenter.

The theory of this mixture of the two phases, sometimes called 'intermediate state' is, therefore, nothing but a consistent application of the theory of the 'pure supraconducting' phase; but formally it forms for itself an independent whole. Here we will only give some of the results.

The variables of the theory of this intermediate state are the *averages* of \mathbf{h} and of \mathbf{e} taken over the microscopic structure. These are the quantities which Lorentz identifies with the quantities \mathbf{B} and \mathbf{E} of Maxwell's theory :

$$\mathbf{B} = \bar{\mathbf{h}} \quad \text{and} \quad \mathbf{E} = \bar{\mathbf{e}}$$

Here we will restrict ourselves to the pure magnetostatic case. The theory can be completely characterized by indicating the free energy F which, it has been calculated, is given by :

$$F = H_T \left[\sqrt{B_x^2 + B_y^2 + B_z^2} - \frac{1}{2} H_T^2 \right] \quad (10)$$

(for $|\mathbf{B}| \leq H_T$)

By its derivatives with respect to B_x, B_y, B_z , the free energy defines the quantities H_x, H_y, H_z

of the macroscopic Maxwell equations. One gets :

$$H_x = \frac{B_x}{\sqrt{B_x^2 + B_y^2 + B_z^2}} H_T, \text{ etc.} \quad (11)$$

This equation can be simply interpreted by stating that in the intermediate state there is a diamagnetic permeability dependent on \mathbf{B} which for $\mathbf{B} \leq H_T$ is given by

$$\mu = \frac{|\mathbf{B}|}{H_T}$$

Moreover, one has the equations

$$\text{curl } \mathbf{H} = 0 \quad \text{div } \mathbf{B} = 0$$

and the usual boundary conditions.

Although on account of equation (11) this theory is not a linear theory (like the theory of the pure supraconducting state or the ordinary Maxwell theory), it is nevertheless of extreme simplicity; (11) simply states that the magnetic field strength \mathbf{H} is always parallel to the magnetic induction \mathbf{B} , but that it has always the absolute value H_T , independently of the value of \mathbf{B} . From this, among other things, it follows that, in the domain of the magnetostatics of the intermediate state, the magnetic lines of force are always straight lines.

For $\mathbf{B}=0$, however, according to (11) the field \mathbf{H} is not defined as to its intensity or as to its direction. This comes from the fact that for $\mathbf{B}=0$ the pure supraconducting regions become unlimitedly large, which signifies that the description with the mean values \mathbf{B} and \mathbf{H} can no longer be legitimate and that one has now explicitly to apply the equations of the pure supraconducting state to the superconductor as a whole. Obviously the case $\mathbf{B}=0$ cannot simply be considered as a limiting case of the non-linear theory.

8. We cannot enter here into a detailed discussion of the relation between theory and experiment. On the whole, one can say that the results of the theory agree fairly well with the experiments. With respect to the pure supraconducting state there is full agreement. Practically there exist three phenomena only : (1) the permanent current in a ring ; (2) the current without electric field in an open supraconducting wire, which is fed by normal conducting leads ; (3) Meissner's experiment. The consistent representation of these experiments was the basis of our theory. The greater part of the experiments (actually the Meissner effect also) concerns the transition between the normal and the supraconducting state and deals therefore with the intermediate state. Particularly striking in this respect are recent experiments of De Haas and Guinau, of Mendelssohn and of Shoenberg* as to the transition, qualitatively discussed above, of a sphere in a magnetic field. These experiments are in very

good agreement with the statements of our theory of the microstructure. In many cases, it is true, the experiments¹⁰ of the transition phenomena seem yet to be obscured by hysteresis and other retardation effects, which prevent the realization of thermal equilibrium and render difficult the theoretical discussion. The theory can also account qualitatively for these disturbing effects¹¹, though there still remains something to be done. But for a reasonable discussion of these questions we would have to occupy ourselves with much more detail than could be given here.

The macroscopic theory we have discussed shows that it is possible to interpret the phenomena in a way which avoids the paradoxes that seemed hitherto to render impossible any theory of superconductivity. The new interpretation includes, moreover, a very simple description of the phenomenon in the language of wave kinematics. The next stage will have to be the

development of the electronic basis of this theory. One might presume that the new aspect here presented of superconductivity may also give an indication for the construction of a molecular model of the superconductor¹².

¹⁰ The following interpretation seems first to have been given by Gorter, C. J., *NATURF.* 132, 931 (1933). Gorter, C. J., and Casimir, H., *Physica*, 1, 305 (1934).

¹¹ London, F., *Physica*, 3, 450 (1936); *NATURE*, 137, 991 (1936).

¹² The magnetostatic part of this theory has also been developed by Peleris, R., *Proc. Roy. Soc., A*, 155, 613 (1936), quite independently of our conceptions, as a pure phenomenological description of a new 'intermediate' state, different from both the pure superconductive and the normal state. But it can be shown¹³ that, thermodynamically speaking, the intermediate state has not to be considered as a further independent phase but as a mixture of the two phases.

¹³ De Haas, W. J., and Guinieu, A., *Physica*, 2, 182, 534 (1936). Mendelssohn, K., *Proc. Roy. Soc., A*, 155, 558 (1936). Shoenberg, D., *Proc. Roy. Soc., A*, 155, 712 (1936).

¹⁴ For example, De Haas, W. J., and Casimir-Jonker, M. J., *Physica*, 1, 201 (1934).

¹⁵ London, H., *Proc. Roy. Soc., A*, 152, 650 (1935). Keesom, W. H., and Van Laer, P. H., *Physica*, 4, 499 (1937). Grayson Smith, H., *Trans. Roy. Soc. Canada*, 31, 31 (1937). De Haas, W. J., Enguikios, A. D., and Guinieu, O. A., *Physica*, 4, 595 (1937).

¹⁶ (Added in the proofs). In a paper just published (*Phys. Rev.*, 52, 214 (1927)), J. C. Slater has tried to sketch such a molecular model for our theory. See also Slater, J. C., *Phys. Rev.*, 31, 195 (1937), and London, F., *Phys. Rev.*, 31, 678 (1937).

Bicentenary of the Birth of Galvani Celebration at Bologna

THE great contribution of Luigi Galvani to the advancement of the sciences of electricity and electro-physiology has been fittingly celebrated by a scientific congress held on October 17-20 at the invitation of the City and University of Bologna, the historic centre of learning where Galvani worked.

Galvani was born on September 9, 1737. In his early years it is recorded that he wished to enter the Church, but that on the insistence of his family he took to the study of medicine, and at twenty-five years of age had become lecturer in anatomy in the University of Bologna. Here his work lay in the field of anatomy and physiology until his great electro-physiological discovery made in 1791. It has been stated that the discovery arose from an observation that when animals were suspended on iron railings by copper hooks, a twitching of the muscles resulted. His published work states, however, that he observed the twitchings in the dissected muscles of a frog's leg whenever a spark was passed from a neighbouring electric machine to some other object, the only condition being that the animal should be in contact with some metal or other good conducting substance. A further experiment showed that the same convulsions could be obtained by the "sole application of some conducting arc", of which one extremity touched the muscles and the other the

nerves or spine of the frog. The motion was believed by Galvani to result from a union of the negative charge of the muscle with the positive electricity proceeding along the nerve.

The discovery attracted the attention of Volta, working in Como, who thereupon made an extensive series of experiments. He showed in particular that convulsions could be excited in the legs or other members of the animals by "metallic touching either of two parts of a nerve only or of two muscles" provided only that an arc consisting of two metals was employed. He ascribed the effects seen to the electricity produced by the contact of dissimilar metals, and showed also that the electric current acted not on the muscles directly but through the medium of the nerves. These results, which were communicated to the Royal Society in 1793 by his countryman Cavallo, led directly to his construction in 1800 of the voltaic pile.

At the opening session of the recent Congress, attended by the King and Queen of Italy and members of the Government, Prof. Q. Marjorana delivered a commemorative address on the life and work of Galvani. Later in the day the delegates were invited to a formal opening of a library and collection of records of Galvani. For these sessions, Bologna made public holiday. The streets were lined with troops; girls from the villages paraded

in traditional costume, the *Bafile* were out in force, and the sober black of the party uniform contrasted vividly with the splendour of historic costumes and academic robes. We cannot, it seems, compare with the totalitarian States in our devotion to men of science of the past.

The scientific work of the Congress was divided as was fitting into sections dealing with physics, experimental biology and radiobiology. At the plenary session, addresses were delivered by Prof. Niels Bohr on biology and atomic physics, by Prof. E. D. Adrian on the electrophysiology of the sense organs and by Prof. A. Gunsett on radiobiology and radiotherapy.

Prof. Bohr discussed the bearing on biological problems of the latest developments of atomic theory. In particular he discussed how far the limitation of the classical idea of causality resulting from the "Principle of Uncertainty" could serve to harmonize the mechanistic and vitalistic views of biological processes. He pointed out that the absorption of only a few light quanta or perhaps one light quantum is sufficient to produce a retinal impression, and that the limitation to the efficiency of the eye is almost certainly imposed by the atomic nature of the light quantum. It seems probable also that other organs have similar limits. Furthermore, it appears that the regularities peculiar to atomic processes which are foreign to causal mechanics are at least as important for the understanding of the behaviour of living organisms. Atomistic features are therefore of essential importance in biological processes.

The recognition of this importance is not, however, sufficient for a comprehensive explanation of biological processes, and it becomes necessary to examine the position of the vitalists, that a peculiar force unknown to physics governs all organic life. Prof. Bohr believes, however, with Newton that the foundation of science is the belief that Nature under the same conditions will always exhibit the same regularities. If, therefore, the analysis of the mechanism of living organisms could be probed as far as that of atomic phenomena, one would scarcely expect to find any features differing from the properties of inorganic matter.

It is necessary to remember, Prof. Bohr continued, that biological experiments differ from physical experiments in the necessity for keeping the organism alive, and that this restriction imposes uncertainties as to the physical conditions to which they are subjected. It might well be that this uncertainty is just sufficient to allow the organism to conceal from us the secrets which are connected with life, just as in physical experiments the disturbance produced by observation often prevents a strictly causal description of the phenomena. Great caution should, however, be

exercised in such considerations, and he considered that quite unwarranted applications of the "Principle of Uncertainty" have been made by many writers.

Prof. E. Fermi gave an account of the beautiful experiments carried out by his school in Rome on the properties of neutrons and on the important information obtained on the position and life of excited states of nuclei. He described experiments which show that fast neutrons lose the greater part of their energy on scattering by heavy nuclei such as lead.

Prof. G. v. Hevesy gave an account of his work on the use of radioactive phosphorus as an indicator in biological processes. Radiophosphorus, which can be produced in large quantities by a transmutation process, emits electrons and decays with a convenient period of 14 days. By adding radiophosphorus to the food of animals, the path of the phosphorus atoms can be traced through the different stages of the metabolic process. Thus the greatest part of the phosphorus enters the blood stream, and after a few minutes the bulk of the phosphorus atoms present in the blood in the phosphate stage will exchange places, principally with those present in the skeleton but also with those present in the muscles and other organs. At an appreciably slower rate proceeds the synthesis of the numerous organic phosphorus compounds present in the organism.

Prof. P. Debye described new experiments on the dielectric loss in liquids, using undamped electric waves having a wave-length of the order of a centimetre. The experiments show that molecular rotation does not play a great part in the dielectric loss, probably owing to the rotation being prevented by the quasi-crystalline structure of the liquid. The loss seems rather to result from relative motion of the component units of the molecule.

Prof. W. Bothe gave two new examples of the existence of radioactive isomers—atomic nuclei having the same charge and mass but having different decay constants. Thus ^{80}Br can be produced either by adding a neutron to ^{79}Br or by detaching a neutron from ^{81}Br . In both cases two radioactive products are produced having half-lives of 18 min. and 4.2 hours. He gave also new information on the resonance energies of light nuclei, showing that the same resonant states can be produced by different types of transmutations.

Prof. W. Heisenberg discussed the mechanism of shower production by cosmic rays. He differentiated between two processes. In the cascade process, showers are built up from the successive conversion of electron energy into radiation, radiation into pair production and then further loss of electron

energy to radiation. This process, described theoretically by the theories of Oppenheimer and Coulson, Bhabha and Heitler seems to be confirmed by Wilson chamber photographs of Street and Stevenson showing the 'build up' of the shower. A second process results from the conversion of the energy of a heavy particle into positive and negative electrons through the intermediary of proton-neutron transitions. Experimental results on cosmic rays were discussed by Prof. B. Rossi.

Dr. F. W. Aston gave an account of his recent measurement on the masses of nuclei by the method of close doublets, and Prof. M. L. E. Oliphant and Dr. J. D. Cockcroft described other recent work of the Cavendish and Mond Laboratories, Cambridge, including a description of the new High-Voltage Laboratory and its equipment and the recently reported peculiar properties of liquid helium.

In all, about twenty physical papers were communicated to the Congress.

Obituary Notices

Mr. W. S. Gosset: "Student"

WILLIAM SEALY GOSSET, who died after a short illness on October 16, was best known to statisticians throughout the world by his pseudonym "Student", under which his scientific contributions were published. He was born on June 13, 1876, and became in turn a scholar at Winchester and at New College, Oxford, where he worked at mathematics and chemistry. In 1899 he joined the firm of Arthur Guinness, Son and Company, and a few weeks before his death had been appointed head brewer; his handling of statistics was only one of many duties.

Gosset's work brought him at an early stage against the problem of interpreting routine tests in chemical analysis, and at the suggestion of one of his chiefs he turned his mind to the question of what help the theory of probability could bring to the practice of brewing. He first met Karl Pearson in the summer of 1905, and a year later went to London to spend some months in the Biometric Laboratory at University College. Throughout his life he was to gain much from the continuation of this contact between 'student' and 'professor', but from the very beginning he launched out on research lines of his own which were to prove of very great importance to the development both of the theory and practice of mathematical statistics.

Under Galton, Weldon and Pearson, the Biometric School had been mainly concerned with the handling of comparatively large samples from biological populations, but Gosset in his daily work was forced to attempt to draw conclusions, leading to executive action, from the analysis of relatively small numbers of observations. Thus he might need to answer such a question as, "What is the accuracy of this arithmetic mean based on 8 observations (the population standard deviation being unknown)?" Thirty years ago a statistician was forced to reply somewhat as follows: "Following the method appropriate for large samples the odds are 19 to 1 that your unknown population mean lies between (say) 22.1 and 24.6, but as the sample is so small this statement is entirely unreliable." Gosset's work has, however, made possible a far more useful answer, namely, "If you have taken reasonable precautions to see that your sample is randomly selected, the odds are 19 to 1 that the

limits 21.8 to 24.9 include the unknown population mean." At the expense of somewhat broadening limits which before had little meaning, definite information has replaced a counsel of despair. This process of making full allowance within the statistical test itself for uncertainty regarding the standard deviation due to small numbers, by use of what in fact are ratios instead of absolute measures, has sometimes been termed 'studentizing'; the conception involved has been the basis of a rapid theoretical advance without which many of the problems of agriculture and industry could scarcely have been brought within the range of statistical inquiry.

But Gosset's contribution was only in part a theoretical one; he recognized the risks involved in basing action on the application of statistical calculus to few observations, yet all his work as a practical statistician in industry went to show that, with due precaution, these risks could be taken with economic advantage. Thus all that he wrote, whether on the reliability of the mean and standard deviation, on methods of measuring correlation, on the problem of counting cells with a haemocytometer or on the checking of routine analysis, helped to give confidence to those who were trying to apply similar methods in the face of scepticism or even opposition.

Besides dealing with questions which concerned the chemist and biologist, Gosset's work led him into the field of agricultural experimentation. His paper of 1923 "On Testing Varieties of Cereals" was one of the most important early contributions to an era which has been notable for the introduction of precise statistical methods into agricultural research. His influence spread very widely in later years, not only through the medium of his written papers, but also through a correspondence which linked him to experimenters all the world over. He was always ready with advice and friendly criticism, and many must have gained from his suggestive mind the initial ideas which have borne fruit in their later research.

Much could be written, if space allowed, of the charm of Gosset's personality, with its modesty, unconventionality and tolerance. It is to be hoped that it will be possible to do fuller justice elsewhere to a man who has occupied a very special place in the hearts of so many friends in Great Britain and abroad.

E. S. P.

The Right Hon. J. Ramsay MacDonald, F.R.S.

THE sudden death of Mr. Ramsay MacDonald from heart failure, on Tuesday night, at seventy-one years of age, while on a voyage to South America, will be deeply regretted by his many friends in scientific circles. He left England on November 4 for a three months' holiday, which he described as "the first he had ever had free from care", and a wireless message stating that he passed away on November 9, at 8.45 p.m., was received a few hours later.

Mr. MacDonald's last speech in public was made at the Royal Institution on October 22, when he delivered the Radford Mather lecture of the British Association on "Science and the Community". The main part of this discourse was published in *NATURE* of October 30, and it is of melancholy interest to record that the same issue contained personal appreciations of the work and influence of his friend, Lord Rutherford, to whom he referred in terms of affectionate regard in his lecture.

As a young man, Mr. MacDonald was a keen student of science, and it was through the accident of circumstances that his interests were diverted into social and political fields. When he went to Bristol more than fifty years ago, to take charge of a boys' club, his ambition was to become a science teacher, and he took particular interest in geology. It happened, however, that he came into contact with a very remarkable group of social reformers in Bristol at that time and soon associated himself with their movement. Even when he left Bristol to come to London he continued his studies of scientific subjects at the Birkbeck College and privately with the view of obtaining a scholarship or exhibition upon successful results in the old Science and Art Departments examinations. It was impossible, however, for him to find sufficient time for the intensive study required, outside his daily working hours, to prepare himself for one of the scholarships then tenable at the Normal School of Science, South Kensington, now the Royal College of Science, and he had to abandon his early hopes.

It was through his social work that Mr. MacDonald became associated with the daughter of Dr. J. H. Gladstone, F.R.S., the distinguished chemist, and niece of Lord Kelvin, and they were married in 1896. They worked together for social reform in complete sympathy until Mrs. MacDonald's death in 1911; one of their two sons is Mr. Malcolm MacDonald, Secretary of State for Dominion Affairs.

After Mr. MacDonald had resigned his office as Prime Minister and First Lord of the Treasury in 1935, he became Lord President of the Council, and as such was responsible to Parliament for the reports of the Department of Scientific and Industrial Research, in the work of which he took particular interest. He was elected a fellow of the Royal Society in 1930 under the special rule which provides for the election of a limited number of persons who "have rendered conspicuous service to the cause of science". He was elected a member of Parliament for the Scottish Universities in 1936 and held this seat at the time of his death. This is not the place to survey

his political career or his influence as a statesman, but we are glad to express grateful appreciation of the encouragement he always gave to scientific work and to record the esteem in which his memory is cherished in scientific circles.

Prof. E. J. Rapson, F.B.A.

WE regret to record the death of Prof. E. J. Rapson, professor of Sanskrit in the University of Cambridge, which took place suddenly at Cambridge on October 3, at the age of seventy-six years.

Edward James Rapson, the son of the Rev. E. Rapson, vicar of West Bradley, Somerset, was born on May 12, 1861, and was educated at Hereford Cathedral School and St. John's College, Cambridge, where he was elected a classical foundation scholar in 1883. He studied Sanskrit under Cowell and Bendal, taking a first class in the Classical Tripos of 1883 and the Indian Languages Tripos two years later. He was awarded the Brotherton Sanskrit scholarship in 1885 and the Le Bas prize in 1886, and was elected to a fellowship at St. John's in the following year. In the same year he became librarian of the Indian Institute, Oxford, where he was associated with the then Boden professor, Sir Monier Monier-Williams. A few months later he joined the staff of the British Museum, taking charge of the collection of Indian coins. In 1903 he was appointed professor of Sanskrit in University College, London, and in 1906 went to Cambridge, where he occupied the chair in Sanskrit until his retirement in 1936, when he was accorded the title of emeritus professor.

Pre-eminent as scholar and teacher in Sanskrit, it was through palaeography and numismatics, and more especially the numismatics of the early Indian dynasties, that Rapson made his outstanding contributions to Indian studies. When he joined the staff of the British Museum, knowledge of the early history of India was largely a blank. It was in great part owing to his studies that this gap has been filled to no little extent. Of this the evidence will be found in his "Indian Coins" (1897), his contributions to the British Museum catalogue of Indian coins, and his communications in the *Numismatic Chronicle*, of which he was editor, the *Journal of the Royal Asiatic Society*, and other scientific and learned periodicals. His abilities as scholar and historian found wider scope as editor of the first two volumes of the "Cambridge History of India". The first volume, on Ancient India, to which he himself contributed four chapters, was published in 1922; but the second is still uncompleted, though the later volumes have appeared.

WE regret to announce the following deaths:

Prof. H. B. Fantham, Strathcona professor of zoology in McGill University, Montreal, since 1933, professor of zoology and comparative anatomy in the University of the Witwatersrand, Johannesburg, in 1917-32, on October 27, aged sixty years.

Dr. J. A. Voeleker, C.I.E., consulting chemist to the Royal Agricultural Society of England, on November 6, aged eighty-three years.

News and Views

Royal Society Medallists and Officers

HIS MAJESTY THE KING has been graciously pleased to approve the following recommendations made by the council of the Royal Society for the award of the two Royal Medals for the current year: Prof. N. V. Sidgwick, in recognition of his distinguished, stimulating and continuous work on valency and on molecular structure; Prof. A. H. R. Buller, in recognition of his researches on the general biology and sexuality of the Fungi. The following awards have been made by the president and council of the Royal Society: Copley Medal to Sir Henry Dale, in recognition of his important contributions to pharmacology, particularly to the pharmacology of muscle and of neuromuscular transmission; Davy Medal to Prof. Hans Fischer, in recognition of his work on the chemistry of the porphyrins, particularly his determination of their detailed structure by degradation and his syntheses of porphyrins of biological importance; Buchanan Medal to General F. F. Russell, in recognition of his work in relation to public health problems in many parts of the world on behalf of the International Health Division of the Rockefeller Foundation; Sylvester Medal to Prof. A. E. H. Love, in recognition of his researches in classical mathematical physics, particularly the mathematical theories of elasticity and hydrodynamics; Hughes Medal to Prof. Ernest O. Lawrence in recognition of his work on the development of the cyclotron and its application to investigations of nuclear disintegration. The following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting on November 30: *President*, Sir William Bragg; *Treasurer*, Sir Henry Lyons; *Secretaries*, Sir Frank Smith and Prof. A. V. Hill; *Foreign Secretary*, Sir Albert Seward; *Other Members of Council*, Prof. R. Whytlaw-Gray, Prof. G. P. Thomson, Prof. J. Proudman, Prof. D. M. S. Watson, Dr. F. L. Pyman, Prof. E. J. Salisbury, Prof. S. P. Bedson, Prof. M. Greenwood, Prof. J. Mellanby, Sir Thomas Holland, Dr. G. T. Bennett, Prof. J. Chadwick, Prof. D. Keilin, Prof. J. Graham Kerr, Sir Robert Pickard, Mr. H. R. Ricardo.

Ludwig Stieda (1837-1918)

CHRISTIAN HERMAN LUDWIG STIEDA, an eminent German anatomist, was born at Riga on November 19, 1837, the son of a tradesman. His medical education was carried out at Dorpat, where his teachers in anatomy were Reissner, Bidder and Kupffer, and he won a silver medal in anatomy. After qualifying in 1861 he went to Giessen, where Leuckart inspired him with an interest in the anatomy of worms, and later to Erlangen, where he studied under Gerlach and Herz. In 1862 he moved to Vienna, where he attended lectures by Oppolzer, Skoda, Hebra, Hyrtl

and Bruecke, with the last of whom he studied histology. In 1864 he was appointed prosector at Dorpat and in the following year lecturer on comparative anatomy in the veterinary school there. In 1866 he was elected extraordinary professor of anatomy and nine years later full professor in succession to his former teacher Reissner. He held this office for ten years, during the last three of which he was dean of the medical faculty. In 1885 he was appointed director of the anatomical institute at Königsberg, where he remained until his retirement in 1912. His death took place at Giessen on his birthday on November 19, 1918. As well as being a successful and attractive lecturer, Stieda was a man of very wide interests and a prolific writer, as is shown by the bibliography of his works compiled by Feisler (*Anat. Anzeiger*, 52, 134-42; 1919-20). His anatomical investigations included comparative studies of the central nervous system in vertebrates, the formation of bone, and the development of the lungs, thymus, thyroid and carotid glands. His interest in the history of medicine is shown by his biographies of naturalists and medical men. He was also the author of several articles and reviews on archaeological, anthropological and ethnographical subjects.

The Writings of Galvani

IN connexion with the commemoration at Bologna of the bicentenary of the birth of Galvani, attention may be directed to an interesting memoir in the *Annals of Science*, 1, No. 3, July 1936, by Prof. J. F. Fulton and Prof. H. Cushing, of the Yale University School of Medicine, entitled "A Bibliographical Study of the Galvani and the Aldini Writings on Animal Electricity". Modest and shy, Galvani showed the greatest indifference to having his name appear in print, and thus out of all the known discourses or lectures prepared by him during the twenty-five years between his professorial appointment and the appearance of his famous "De vivibus electricitatis", only three, making a total of thirty printed pages, appear to have been published. Galvani's lack of self-assurance was not, however, shared by his nephew Giovanni Aldini (1762-1834), professor of physics in the University of Bologna, and it was he who took up the cudgels in defence of his uncle's thesis. Galvani's memoir appeared early in 1791 and two reprints were issued the same year. Next year, after Volta's criticism of Galvani's views, Aldini published an edition with annotations, and a German translation was made by Dr. J. Mayer (1752-1807) in 1793. The subject of animal magnetism had by then become a matter for widespread controversy. Galvani died in 1798, but a year or two later Aldini visited England, gave lectures on galvanism at Guy's and St. Thomas's Hospitals and was presented with a gold medal. His "Improvements

in *Galvanism*", printed in London in 1803, has the title-page embellished with a representation of the medal. Altogether twenty-eight items are included in the bibliography, all of them being very fully described, while there are photographs of several of the title-pages.

Radcliffe Observatory, Pretoria

THE date of completion of the 74-inch reflector for the new Radcliffe Observatory at Pretoria has been further postponed by a second unsuccessful attempt to cast the disk of Pyrex glass for the large mirror. The first disk was cast by the Corning Glass Company in July 1936, and on being taken from the annealing oven in the following December was found to be useless. A second disk was cast in June of this year, and the disappointing, and unexpected, news has recently been received that this disk also has been a failure. The company is proceeding to make a third disk, and it is to be hoped that on this occasion better fortune will attend its efforts. The other arrangements, though somewhat behind schedule, have been proceeding with greater smoothness. The buildings of the Observatory on the magnificent site to the south-east of Pretoria, 600 feet above the city, which was generously presented to the Radcliffe Trustees by the municipality, are nearly completed. They consist of an office block, three residences and the circular building of brick and concrete to house the telescope.

THE Radcliffe observer (Dr. H. Knox-Shaw) and Mr. E. G. Williams, the second assistant, have already taken up residence at the Observatory, but Dr. R. O. Redman, the chief assistant, is remaining in England for the present to superintend the construction of subsidiary apparatus. The steel revolving turret, under construction by the Cleveland Bridge Company, is due to reach Pretoria early in the new year, to be followed a couple of months later by the mechanical parts of the telescope, which Sir Howard Grubb, Parsons and Co. have nearly finished. It had been planned to have the large mirror for the 74-inch telescope aluminized when completed, in view of the marked success of this form of reflecting surface as applied to the large mirrors in America. There is, however, no apparatus in England capable of dealing with a mirror of this size, and the estimated cost of the outfit, vacuum chamber and pumps, namely, £1,500, is much more than the resources of the Radcliffe Trustees, already greatly strained by the recent rise in the cost of materials, can afford. It seems likely, therefore, that the new telescope, although thoroughly up to date in other respects, will have, at any rate to begin with, a silvered mirror.

Exhibition of Wilson Track Photographs

It is now twenty-five years since C. T. R. Wilson first succeeded in making visible and photographing the tracks of single ionizing particles by his condensation method. An exhibition has been arranged at the Science Museum, South Kensington, to

illustrate the great variety of effects which have been investigated by means of Wilson chambers during the past twenty-five years. The exhibition will be open free to the public from November 19 until the end of February 1938. The centre-piece of the exhibition is Wilson's original apparatus with which the photographs published in 1912 were taken; the apparatus has been kindly lent by the Cavendish Laboratory, Cambridge, where Wilson's pioneer work was carried out. The remainder of the exhibition consists of a collection of more than eighty photographs, which have been contributed by research workers from many countries. An introductory group of twelve photographs illustrates in as simple a way as possible some of the main properties of alpha and beta rays, X-rays and cosmic rays, for the benefit of those who are not familiar with them. The main collection of photographs is arranged in a series of groups showing typical effects produced by alpha, beta and gamma rays, X-rays, protons, deuterons, neutrons and cosmic rays, while a small group illustrates the phenomenon of induced radioactivity. The section devoted to cosmic rays includes a copy of the photograph taken by Anderson in 1932 which gave him conclusive evidence for the existence of the positive electron, while the discovery of cosmic-ray 'showers' is illustrated by copies of Skobelzyn's pioneer photographs, from which he showed that pairs and groups of 'straight' cosmic ray tracks occur more frequently than is to be expected by chance. In order to bring home to visitors to the exhibition the three-dimensional character of Wilson tracks a number of pairs of stereoscopic transparencies have been mounted for viewing in turn in a stereoscope. A small handbook (London: Science Museum, or H.M. Stationery Office, 6d., by post 7d.) has been prepared by Dr. F. A. B. Ward, an officer of the Museum, who has arranged the exhibition.

Indian Hydro-electric Development

THE hydro-electric power scheme, known as the "Ganges Grid", was formally inaugurated on November 2, when Sir Harry Haig, Governor of the United Provinces, opened two new generating stations near Meerut, which are supplied with water-power from the Ganges Canal. The potentialities of the canal as a source of power were first investigated in 1920 in connexion with a series of local applications, and these gradually led to the development of the available resources on a larger scale, in order to extend the benefits of agricultural irrigation over a wide area. The exploitation of the "Grid" project has cost Rs. 343 lakhs (more than £2,500,000) and it now produces a gross output of 29,000 kilowatts. The energy is distributed by means of some four thousand miles of transmission lines to 1,600 sub-stations scattered over the eight western districts of the United Provinces; thence it is supplied to 88 towns for the purpose of pumping water from rivers or from State tube-wells for land irrigation. The power is also utilized to work agricultural machinery on private farms. Sir Harry opened at the same time the State tube-well irrigation system, consisting

of considerably more than a thousand wells, the greater number of which are in operation and irrigate an area of a million and a half acres. The capital outlay on the system has been about Rs. 126 lakhs (£945,000). The execution of the "Grid" project has been in the hands of Sir William Stampe, formerly chief engineer of the Irrigation Department of the United Provinces.

Tring Museum

ABOUT the time of the recent meeting of the British Association in Nottingham, it was announced in the Press that the late Lord Rothschild had bequeathed the buildings and collections of his museum at Tring to the nation on condition that the trustees of the British Museum should undertake their custody and maintenance. The president of the Association, Sir Edward Poulton, expressed in his address the hope that this condition would be accepted, and the committee of Section D (Zoology) forwarded a resolution to the Council, recording its opinion "that the continuance of the Tring Museum as an active centre of scientific research is a matter of the utmost importance from a national, and indeed from an international, point of view. For many years", the resolution continues, "the collections preserved there, more particularly the vast and unequalled collection of Lepidoptera, have attracted research workers from all over the world and have been the means of adding largely to our understanding of the problems of geographical variation. The Sectional Committee earnestly desire that the permanent conservation of these collections and the continuance of the facilities for their study provided by the munificence of the late Lord Rothschild will be ensured by their being placed in the custody of the Trustees of the British Museum." The Council of the Association has now adopted this resolution.

Royal Institute of International Affairs

THE report of the Council of the Royal Institute of International Affairs submitted to the eighteenth annual general meeting on November 2 refers to the establishment of a chair of international economics at the Institute, Chatham House, London, S.W.1, as a result of a gift of £20,000 from Sir Henry Price. Prof. Allan G. B. Fisher, of the University of Western Australia, has been appointed as the first holder of this chair and will assume his duties in January 1938. It is hoped that this is the first of what will become a group of research chairs devoted to the study of international affairs, and the council contemplates the establishment of research chairs in British Commonwealth relations, international law and institutions and Far Eastern affairs as soon as provision can be made for them. In addition to these important developments, which were largely inspired by the work of Prof. Arnold Toynbee, holder of the Stevenson research chair in international history, the council has been able to maintain its programme of research by individual scholars and by study groups through the support of the trustees of the Rockefeller

Foundation, who in January 1937 renewed for a further five years their grant of £8,000 a year. Four reports in the Study Group Series were completed during the year, covering "The British Empire", "The Problem of International Investment", "The Colonial Problem" and "The Republics of South America: a Political, Economic and Cultural Survey". Particulars of these, and of other publications of the Institute, are included in an appendix. The Rockefeller Foundation has also made a special grant for an investigation of the refugee problem. The report includes particulars of a number of other research projects which are in progress as well as meetings held and study groups in being. It is expected that the African Research Survey will be completed and published early in 1938, the preliminary survey having been extended to cover administration, economics, scientific research and social relations.

Tyneside Geographical Society

THE Tyneside Geographical Society celebrated its fiftieth year of existence at Newcastle-upon-Tyne on November 4-6. On November 4 a jubilee meeting was held with the president of the Society, the Duke of Northumberland, in the chair. The chief speaker at this meeting was Sir William Goodenough, who was one of the two representatives of the Royal Geographical Society at the celebrations. After this meeting, a dinner was held at the Royal Station Hotel, when Lord Polwarth, president of the Royal Scottish Geographical Society, proposed the health of the Tyneside Geographical Society. Sir Thomas Oliver acknowledged the toast and included in his response references to the past activities of the Society over the last fifty years. The health of the guests was proposed by Mr. Herbert Shaw, who held the office of secretary of the Society for nearly forty years. He expressed the gratitude of the Society to the Royal Geographical Society, the Royal Scottish Geographical Society, the Geographical Association and the Manchester Geographical Society for sending representatives to the celebrations. The toast was acknowledged by Lord Eustace Percy, rector of King's College, and by Prof. E. G. R. Taylor of Birkbeck College, University of London. On November 5 the Herbertson Memorial Lecture of the Geographical Association was delivered in King's College by Prof. A. G. Ogilvie, of the University of Edinburgh. The subject of the lecture was "Minerals, Land Forms and Life". On November 6 an exhibition of geographical materials, publications and appliances was held, the official opening ceremony being performed by Lord Eustace Percy.

County Library at Ruislip

THAT a timbered barn, reputed to be of medieval age, used in olden days for the storage of corn and later for haybinders' work and general farm products, might be saved by its own appeal through adaptation for the needs of a public county library is a consideration which might well enter the minds of educational authorities in those rapidly expanding rural areas where sites are valued at exorbitant rates

of purchase. On November 2, Prof. J. H. Clapham, vice-provost of King's College, Cambridge, performed the ceremony of opening at Ruislip, Middlesex, the "Little Barn" (so called for generations) appertaining to the ancient Manor of Ruislip, and now being used as a county library. The homestead of the farm, it should be said, originally constituted, with the acres around, but a fraction indeed of the extensive tracts owned formerly at Ruislip by King's College, Cambridge, the gift of its founder, Henry VI. Not long ago, the College conveyed the farm and surrounds to the people of Ruislip as a gift. Hence the presence of Prof. Clapham was specially opportune and relevant to the occasion. The requisite funds for the adaptation and library furnishing equipment of the barn for its new purposes were provided by the Middlesex County Council, supported by the unwearied efforts of the Middlesex Education Committee. It is of interest to record that Mr. T. E. James, formerly clerk to the Royal Society, who lives at Ruislip, has been appointed by the Middlesex County Council as a representative on the Ruislip-Northwood Local Library Committee.

Oils from Irish Grown Plants

CORK UNIVERSITY PRESS has issued an Agricultural Bulletin, No. 4, with this title. It contains the record of some small-scale experiments, carried out at Cork and elsewhere in the Irish Free State, on the possibility of producing supplies of oil seeds upon Irish soils. Crops of hemp, linseed, poppy, sunflower, rape, mustard and *Mercurialis annua* have been raised with varying success, and the yield of oils determined, as also the main physical chemical characteristics of the extracted oils. The work has been under the direction of Prof. J. Reilly and Mr. Denis F. Kelly, of the Department of Chemistry, University College, Cork. Very indifferent success was met with in these preliminary trials with the annual sunflower and *Mercurialis*, and the authors seem most impressed with the possibilities of native-grown poppy seed oil displacing cotton seed oil in the edible fat and soap industries in Ireland. These trials are, however, of a very preliminary nature; they throw very little light upon the possibility or otherwise of large-scale cultivation of these crops under Irish conditions, but they do establish the yields and main characteristics of the oils to be expected from such oil seeds grown under such conditions.

Horticultural Research in Australia

THE opening in September of a new laboratory under the Commonwealth Council for Scientific and Industrial Research at Merbein, Victoria, is an indication of the store now set by viticulturists on the provision of scientific services for their guidance. Merbein is in the Mildura district on the River Murray, where the first irrigation settlements were established some fifty years ago. Marked changes have taken place of late in horticultural practices in these areas, following particularly upon studies of soils with consequent modification of quantity and frequency of watering, and upon introduction

of communal drainage schemes. The former danger of ruin of blocks by 'salting', or bringing sodium sulphate and chloride and other salts to the surface by excessive watering and insufficient drainage, is almost a thing of the past. The Council is now preparing plans for a further new laboratory at its citricultural research station at Griffith, N.S.W., in an area watered from the Burrinjuck Dam on the Murrumbidgee River.

National Institute of Agricultural Botany

ON the occasion of the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge, the chairman of the council, Captain D. M. Wills, directed attention to the value of the Institute's system of substations. By means of this organization the Institute is able to make recommendations to farmers which are applicable to all districts (with two exceptions) south of a line drawn between Lancaster and Scarborough. There are at present two defective links in the Institute's chain of substations—the Fens and Wales—and the Institute hopes that these defects will shortly be remedied. At present there are substations at Sprowston, Norfolk; Long Sutton, Hants; Cannington, Somerset; Newport, Shropshire; and Askham Bryan, Yorks; on soils ranging from blowing sand to heavy clay. In every case these substations are attached to an agricultural college, institute or station, and the trials are carried out under the supervision of a crop recorder who is responsible to the N.I.A.B. Although the primary purpose of a substation is the provision of trials upon which recommendations can be based, Captain Wills stressed the importance of another aspect of their work. It is possible for a farmer to visit any of these to see, under conditions which may be very similar to his own, trials of the latest introductions of plant breeders both at home and abroad, growing side by side with established varieties. This should enable him to form an opinion as to the suitability—or otherwise—of new varieties to his particular conditions. Finally, Captain Wills expressed the hope that the establishment of a substation in Wales would lead to the discovery of varieties particularly suited to the poorer soils, both in England and Wales.

Mass Observations of Social Problems

"MASS-OBSERVATION" by C. Madge and T. Harrison, with a foreword by Dr. Julian Huxley, the first of a series of projected pamphlets, outlines the technique of a study of social environment and its effects on lines comparable with much bird-watching and observation of natural history, since, largely because of its empiricism, it has, like them, room for the untrained amateur as well as for the trained man of science (London: Frederick Muller, Ltd., 1937. 1s. net). The three sciences most immediately relevant to mass-observation are psychology, anthropology and sociology, and a fundamental plan for research will be evolved by the central organization as a result of suggestions from observers and scientific experts. In the first place, it is intended to mobilize

a numerous and representative corps of observers and to equip and maintain an efficient central organization in touch with all other relevant research associations, however different their methods. The observers will collect their data, which cover as wide a field as possible in order to provide sufficient cross-references to indicate the probable nature of the bias in any individual report. The scientific expert will be required not only as an observer himself but also in drawing up the plan of work, framing well-constructed hypotheses to be tested by mass-observation methods and in suggesting subjects for detailed inquiry, as well as in the interpretation of the data collected and in securing a more rigorous objectivity. The presentation of the results involves further problems, as not only must facts be collected over the widest possible field, but also they must be made known to the widest possible field. As soon as possible, pamphlets at present projected will deal with such questions as popular superstitions, reasons for watching birds, the meaning given to freedom, and will be based on the work of the observers. They will be followed by cheap editions of relevant scientific books, and a monthly bulletin designed for wide circulation is also contemplated. The central office and filing system is at 6 Grote's Building, Blackheath, London, S.E.3.

Mould and Bacteria Killed by New Lamp

IN the *International Merchant*, a monthly pamphlet published by the Westinghouse Electric International Company at New York, a description is given of the 'Sterilamp', a gaseous conductor tube which produces very decided germicidal radiation at low temperature and low cost. It has taken nine years to develop. It is claimed that it prevents the growth of mould and bacteria on the surface of meat aged at high temperature and high humidity. It also retards the growth of mould on bakery products. Tests have shown that the lamp is useful in pasteurizing milk and beer. It is particularly useful in sterilizing conditioned air. The lamp generates radiant energy of a particular wave-length of which 90 per cent is in a region of the radiant spectrum which has been found to be strongly germicidal. It is made in lengths of 10, 20 and 30 inches, and the 20-inch size requires only 7 watts. Of great importance when making applications to food is the fact that the unit operates at a temperature only about 5° F. above that of the room. The lamp and auxiliary equipment is now on the market.

W. Watson and Sons, Ltd.

MESSRS. W. WATSON AND SONS, LTD., of 313 High Holborn, London, W.C.1, have issued a booklet detailing the history of the firm in celebration of its centenary. Founded in 1837 for the manufacture of optical instruments by William Watson at 71 City Road, the business continued at this address until 1861, when it moved to 313 High Holborn, where it has since remained, and has been continuously carried on by members of the Watson family. The microscope was becoming a feature of the Watson firm in the 'seventies of last century, together with

cameras and lenses, since when telescopes, X-ray equipment, cinematographs, projection lanterns and other optical instruments and apparatus have been manufactured. A pleasing portrait of William Watson, the founder, forms a frontispiece to the booklet, which concludes with a series of plates illustrating the products of the firm during the hundred years of its existence.

Gift to the Royal Cancer Hospital

MR. A. CHESTER BEATTY, who has recently been elected vice-president and a member of the committee of the Royal Cancer Hospital, has purchased the Freemasons' Hospital, Fulham Road, with the intention of presenting the building for conversion into the Research Institute of the Hospital, and Mr. Chester Beatty is equipping the building for this purpose in addition to presenting it to the Hospital. It is well known that the Royal Cancer Hospital has maintained a research institute for many years under the direction of Prof. E. L. Kennaway. Mr. Chester Beatty is also generously entirely re-equipping the Radio-therapeutic Department of the Royal Cancer Hospital, at a cost of some £13,000, with the latest modern high-voltage X-ray therapy apparatus embodying many new features which will prove of inestimable value, not only in the treatment of cancer but also in affording full and adequate protection to both patients and operators during the carrying out of the treatment. The Royal Cancer Hospital is a school of the University of London and, in order to encourage the study of radiology, Mr. Chester Beatty has provided a travelling scholarship which has been accepted by the senate of the University of London. The scholarship will enable a student of radiology, after obtaining the academic diplomas in medical radiology, to spend a year in one of the great radiological clinics of the United States of America.

The National Health Campaign

LAST week, November 1-6, marked the beginning of the second month of the National Health Campaign, which was recently inaugurated by the Prime Minister, and this period has been devoted to the general aspects of the campaign and has aroused considerable public interest. During November and December special emphasis is being laid on the services available for mothers and infants, while in January next the child at a later stage, the school age, will be considered, together with the value of co-operation between home and school. The medium of the campaign varies; numerous posters and leaflets have been issued, public meetings and films have been arranged, and the support of the Press and of the wireless is expected.

Announcements

MISS JEAN BATTEN has been awarded the Gold Medal of the Royal Aero Club in recognition of her many Empire flights.

DR. A. G. FRANCIS has been appointed deputy Government chemist in succession to Mr. Andrew More, who retired on November 3.

THE following appointments have recently been made in the Colonial Service: M. Akenhead, agricultural superintendent, Gold Coast; W. E. T. Bond, agricultural officer, Nigeria; J. S. P. Beard, assistant conservator of forests, Trinidad; R. M. Harley, assistant conservator of forests, Gold Coast; C. A. Banister, dairy bacteriologist, Malta; D. R. Buxton, entomologist, Sleeping Sickness Service, Nigeria; J. Cherry, air survey draughtsman, Tanganyika; K. E. Cowan, inspector of plants and produce, Gold Coast; D. E. Davis, assistant analyst, Medical Department, Hong Kong; W. G. Evans, sleeping sickness control officer, Nigeria; R. K. J. Gascoigne, field officer, Tsetse Research Department, Tanganyika; E. G. Harmer, sleeping sickness control officer, Nigeria; H. Hirst, adviser in animal husbandry, Malta; R. E. Hunter, chief fruit inspector, Palestine; R. R. E. Jacobson, geologist, Nigeria; F. Jones, sleeping sickness control officer, Nigeria; E. M. Kidner, sleeping sickness control officer, Nigeria; R. B. Stonehouse, assistant meteorologist, West African Meteorological Service; I. P. Tamworth, assistant superintendent, Botanical and Forestry Department, Hong Kong; P. E. Trevor, sleeping sickness control officer, Nigeria; E. A. Walters (agricultural superintendent, St. Lucia), agricultural superintendent, Gold Coast; R. Daubney (chief veterinary research officer), director of Veterinary Services, Kenya; J. R. Hudson (veterinary research officer), deputy director of Veterinary Services (Laboratory Services), Kenya; R. W. M. Mettam (veterinary pathologist, Uganda), veterinary pathologist, Nigeria; E. J. Mulligan (senior veterinary officer), deputy director of Veterinary Services (Field Services), Kenya; H. Atkinson (deputy government analyst, Ceylon), government chemist, Cyprus; R. J. Johnston (assistant surveyor general), deputy surveyor general, Ceylon; I. F. Wilson (superintendent of surveys), assistant surveyor general, Ceylon; L. G. Woodhouse (deputy surveyor general), surveyor general, Ceylon.

THE trustees of a fund raised to commemorate Sir William Simpson, the well-known authority on tropical diseases, have offered the London School of Hygiene and Tropical Medicine the fund for the establishment of a prize to be awarded annually to a student obtaining the highest marks at Part I of the January examination for the diploma of tropical medicine and hygiene.

THE Huxley Memorial Lectures of the Imperial College of Science and Technology are now held biennially, and a new series of lectures, commemorating other distinguished men who have served on the staff of the College, was inaugurated in 1936. The second of these lectures will be given on May 4, 1938, in memory of Sir Warrington W. Smyth. Prof. S. J. Truscott has agreed to deliver the lecture, the title of which will be "Metal Mining Enterprise".

THE Home Secretary has appointed the following committee to consider lighting in factories and workshops and to advise about standards of sufficient and

suitable lighting as prescribed in the Factories Act, 1937: Mr. D. R. Wilson, chief inspector of factories (chairman), Mr. J. S. Dow, Mr. John A. Gregorson, Miss Florence Hancock, Prof. H. Hartridge, Dr. C. S. Myers, Sir John Parsons, Mr. William Scholes, Mr. G. W. Thomson, Dr. J. W. T. Walsh, and Mr. H. C. Weston. The secretary of the committee is Mr. R. W. Daniel, to whom all communications should be addressed at the Home Office, Whitehall, S.W.1.

A COURSE of training in the inspection of milk pasteurizing plants will be held at the Royal Sanitary Institute on Thursday, November 25, and Saturday, November 27. Members and associates should apply to the Institute, 90 Buckingham Palace Road, London, S.W.1.

THE British Institute of Adult Education and the National Institute of Industrial Psychology jointly have arranged a conference to discuss the problems of leisure, to be held at Queen Mary Hall, Central Club Buildings, Great Russell Street, London, W.C.1, on Thursday, November 18, at 3 p.m. Invitations are being extended to representatives of organizations engaged in educational, recreative and social work and to selected individuals.

THE portraits of Sir Albert Seward and Dr. F. F. Blackman by Mr. Harold Knight and Mr. Henry Lamb respectively, which were subscribed for by Cambridge friends and British botanists, have been kindly presented to the Botany School, Cambridge. Prof. Brooks and the staff of the School will be "At Home" to subscribers on November 23 at 3.30-5 p.m., when Sir Albert Seward and Dr. Blackman hope to be present.

DR. BERNARD NOCHT, emeritus professor of tropical diseases and tropical hygiene at Hamburg, celebrated his eightieth birthday on November 4.

THE fifteenth International Congress of Ophthalmology will be held in the Semiramis Hotel, Cairo, on December 8-14. The subscription is 50 Swiss francs, and for ladies 25 francs. Further information can be obtained from the secretary, Dr. M. Tewfik, P.O.B. 2001, Cairo.

PROF. M. POLANYI writes further with reference to the paragraph in our News and Views columns of October 30, p. 766, relating to his article on the recent international science congress in Paris. In that note we printed a statement as received from him in his original typescript, together with a correction by him of the editorial modification of it as published in NATURE of October 23. The two statements are contradictory; and Prof. Polanyi now asks us to say that this "was due to my error in sending the editor a typescript in which two symbols (half of a parenthesis and a plural forming 's') were left out. Eliminating these typing errors the text clearly has the sense which I stated in NATURE, October 30, page 766".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 853.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Irregular Ionic Clouds in the E Layer of the Ionosphere

It has recently been found that momentary ionospheric echoes from irregular heights, occasionally as low as 60 km. but generally between 100 and 300 km., can be obtained, even on frequencies well above the critical frequency, if a sufficiently high-power transmitter is used.

A typical example is the (P, t) record shown in Fig. 1. This was taken over an interval of about 40 sec. on a wave-length of 32.35 m. (9,127 megacycles/sec.) at 0049 G.M.T. on the night of November 26, 1936. The transmitter was a high-power commercial station of the Cables and Wireless Co. situated at Ongar, Essex. It was of 40 kw. rating, and was modified to send out impulses of about 1/5 ms. duration at a repetition frequency of 50 per second. The receiver situated at Chelmsford, Essex, was 19.2 km. from the transmitter. The record shows that the echoes differ very considerably from the normal E and F echoes.

By using as a receiving array a pair of frames spaced 20 m. apart in the north-south direction, and determining the difference in phase induced by the signal E.M.F.s in the two aerials, the angle of the ray relative to the axis joining the two aerials can be determined.

The ordinary E and F echoes, presumably reflected from a more or less uniform layer, are vertical or nearly vertical, but this is far from the case for the weak echoes first described. Fig. 2 shows an example of the angular measurements made on January 27,

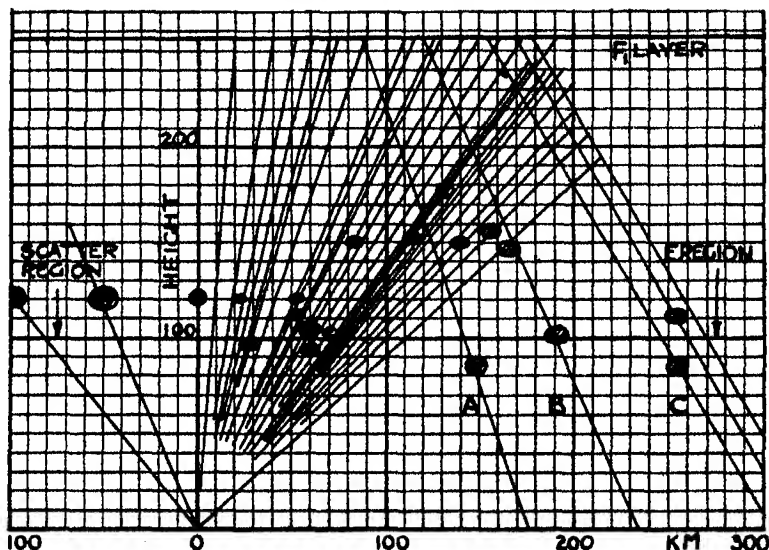


Fig. 2.

1937. The complement of the measured angle gives a lower limit to the angle of incidence, which reaches 45° on occasions.

We can scarcely avoid the conclusion that the echo signals are not regularly refracted from a uniform layer in the ionosphere but are scattered from irregularities or clouds. By plotting the observed equivalent heights along the observed directions, we get an approximate determination of the position of the scatter clouds. The heights so determined are upper limits to the actual heights.

The positions of the clouds all come within or slightly above the E region, if we assume that the few echoes which apparently come from the F_1 region are really reflected at the F_1 layer from points such as A , B , C . The shower of echoes is practically continuous, in the sense that one or more echoes of this type are practically certain to occur in any interval of more than about 5 seconds duration.

This unceasing supply of scatter clouds, which if left to themselves would disappear in the course of a second or so, is a well-established fact, and only explainable on the assumption that there is some

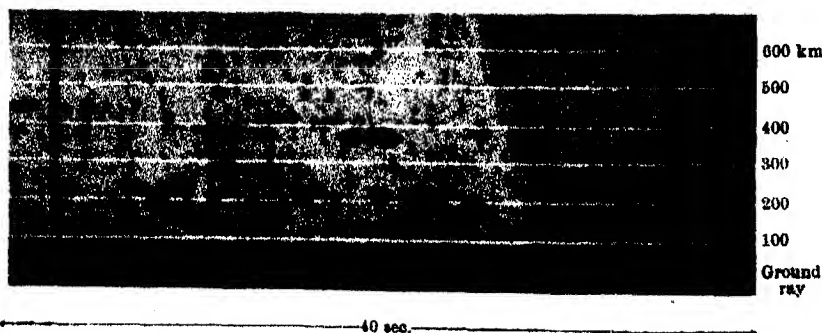


Fig. 1.

P, t RECORD FROM ONGAR (G.O.S. 32.35m.) AT 0049 G.M.T., November 26, 1936.

nearly constant external source of ionization. Many of the disturbances in the outer atmosphere are caused by the emission of ultra-violet light or by charged or uncharged particles from the sun. The evidence, however, that the scatter cloud activity is practically equal day and night at high and low latitudes suggests that the sun is not the prime source of ionization.

Other possibilities include (a) small meteorites; (b) high-speed particles distributed more or less isotropically in space, or emanating from the stars in the galaxy. Disturbances (high-frequency noise) have been shown by Jansky to originate in the Milky Way.

There is some evidence that excessive scatter activity is associated with bright hydrogen eruptions from the sun, and if this is so, the possibility exists of a continuous ionizing supply caused by similar eruptions in the stars of the galaxy.

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Chelmsford.
Sept. 28.

Ancestors of Some Groups of the Present-day Insects

WHILE studying fossil insects from the Middle Permian deposits of the Sylva River basin in the Urals, I have found among them a certain number of new forms that can be considered as predecessors and, in certain cases, as direct ancestors of some groups of modern insects. A few preliminary remarks on the results obtained are given here.

Up to the present time, the origin and geological age of the Embioptera are not exactly known, their fossil remains being found in deposits not older than the Tertiary. Dr. R. J. Tillyard, in 1918¹, pointed out their resemblance to the embiid *Megagnatha odonatiformis* Bolton found in the Carboniferous deposits of Commeny in France; in 1928, he gave a description of the new form *Permembra delicatula* Till., belonging to the special order of Embiopsocida from the Lower Permian of Kansas². In the present year³ he published a paper with a description of a new form, *Protembra permiana* Till., found in the same deposits in Kansas, that belongs, according to him, to the true Embioptera and to his new suborder Protembriaria.

Tillyardembra biarmica n.g. et sp., which is shown in Fig. 1, belongs to a genus that has been named by me in honour of the late Dr. R. J. Tillyard, and I refer it to the true Embioptera but of the independent suborder Epiembriodea. Among the fossils that I had occasion to study, I find, besides the species *Tillyardembra biarmica* n.g. et sp. with long and thin antennae and a tetragonal prothorax, also the species *Tillyardembra antennaeplana* n.g. et sp. with flat antennae and the prothorax in the shape of an irregular rhomb. These forms differ from the modern Embioptera in the following features: (1) the males and females have homonomous wings; (2) the forelegs are of the grasping type without the inflated article of the tarsus with the spinning glands; (3) a large bivalve ovipositor; (4) long multi-articulated cerci. The length of the body of the *Tillyardembra* is 12-15 mm. This genus is very similar to *Protembra* described by Dr. R. J. Tillyard, but differs from it in its dimensions, the size of the ovipositor and other features.

I believe that the ancestors of the whole group of Embiid forms are the Protorthoptera belonging to the family of Spanioderidae^{4,5}. From these must have issued directly the Permian suborder Epiembriodea, then the Protembriaria, and later the present type which, Dr. R. J. Tillyard has pointed out, belong to the special suborder Eutembriaria.

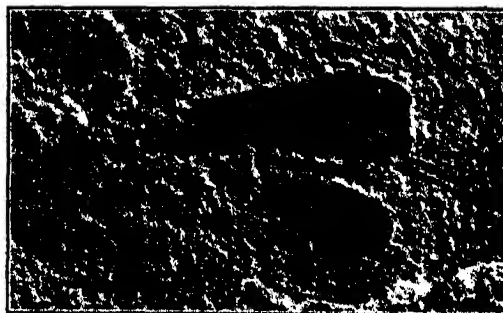


Fig. 1.

Tillyardembra biarmica N.G. ET SP. ENLARGED.
ACTUAL LENGTH, 12 MM.

Last year I recorded the existence of a new order of Hemipsocoptera⁶ phylogenetically connected with Psocoptera and Homoptera⁷. New discoveries induce me actually to modify, in a certain measure, ideas that we had about that group. The new species *Maueria pusillus* nov. sp. (length of the body 5 mm., of the wing 5.5 mm.) with a proboscis-shaped head and many other features shows that the mouth organs of that group were very similar to the sucking apparatus of the Homoptera; the shape of the body and its general appearance are of the type of Psocoptera.



Fig. 2.

Parapsocidium uralicum N.G. ET SP. ENLARGED. ACTUAL LENGTH OF THE WING, 4 MM.

The newly found specimens of Psocoptera of the suborder of Permopsocida lead me to suppose the existence of a sucking mouth apparatus in that group of insects. The new genus and species *Parapsocidium uralicum* n.g. et sp. (Fig. 2) is very close to the genus *Psocidium* described by Dr. R. J. Tillyard⁸, but the comparative study that I have made of the imprints of insects belonging to the order of Hemipsocoptera and the suborder of Permopsocida which I have in my possession induce me to doubt the correctness of the description by Dr. R. J. Tillyard of the chewing mouth organs of the *Psocidium*. The head of the insects of both groups is proboscis-shaped and carries, at the extremity, a sucking apparatus perfectly developed in the Hemipsocoptera and a little less developed in the Permopsocida.

The order Isoptera (termites) has always been found in deposits not older than the Tertiary. In 1935 Dr. A. B. Martynov, comparing the venation of their wings with that of the Protoblattoidea in his report to-

the Russian Entomological Society, suggested that the termites are much more ancient.



Fig. 3.

Uralotermes permianum n.g. et sp. ENLARGED. ACTUAL LENGTH OF THE WING, 18 MM.

I have found a wing imprint of 18 mm. length and 5 mm. width (see Fig. 3) which is much more perfect and more like (in its venation) the wings of some present termites than those of many mesozoic termites. I have called that form *Uralotermes permianum* n.g. et sp. and consider it to belong to the true termites (order Isoptera). I believe that the above-mentioned conclusion supports the theory of Dr. A. B. Martynov about the ancient origin of the termites.

GEORGE ZALESSKY.

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Moscow.
Sept. 19.

¹ Tillyard, R. J., "On the Affinities of two Interesting Fossil Insects from the Upper Carboniferous of Commeny, France", *Proc. Linn. Soc. New South Wales*, 43, pt. 1 (March 1918).

² Tillyard, R. J., "Kansas Permian Insects. Part 12. The Family Delopteridae, with a Discussion of its Ordinal Position", *Amer. J. Sci.*, [v] 16, No. 96 (December 1928).

³ Tillyard, R. J., "Kansas Permian Insects. Part 18. The Order Embiaria", *Amer. J. Sci.*, [v] 33, No. 196 (April 1937).

⁴ Handlirsch, A., "Die fossilen Insekten und die Phylogenie der rezenten Formen" (Leipzig, 1900 8).

⁵ Handlirsch, A., Palaeontologie in "Schröder's Handbuch der Entomologie", 3 (Jena, 1925).

⁶ Zalesky, G. M., "Sur un représentant d'un nouvel ordre d'insectes permien", *Ann. Soc. Géol. Nord.*, 60 (February 1936).

⁷ Tillyard, R. J., "Kansas Permian Insects. Part 9. The Order Hemiptera", *Amer. J. Sci.*, [v] 11, No. 65 (May 1936).

⁸ Tillyard, R. J., "Kansas Permian Insects. Part 8. The Order Copognatha", *Amer. J. Sci.*, [v] 11, No. 64 (April 1936).

Analytical Measurements of Ultracentrifugal Sedimentation

SEDIMENTATION in the ultracentrifuge has so far been followed quantitatively only by optical methods, depending upon the absorption or refraction of light by the substances studied. Even though they have been worked out to a high degree of accuracy, these methods for many important problems need to be supplemented by some procedure allowing chemical tests to be performed in the same run. For example, in a mixture of an enzyme or an antibody with its accompanying impurities, we do not know *a priori* the relationship between optical properties and the amount of active substance, and we cannot therefore definitely state which of the optically observed components in the mixture, if any, carries the activity. As the amount of substances of this kind in most cases can be defined only by an action measured by analytical methods, their sedimentation should be computed from analysis of samples taken out of the ultracentrifugal cell. In this laboratory^{1,2} and elsewhere³, several attempts have been made to take out samples of the ultracentrifuged solutions after concluding an experiment, but the arrangements have not been sufficiently perfect to allow quantitative application.

If we know the amount of substance above or below a certain level in the cell before and after centrifugation, the difference will give us the sedimentation velocity in much the same way as the migration velocity of an ion is calculated from a Hittorf transference experiment. In either case it is a necessary condition that the concentration gradients occurring at the ends of the column of solution do not reach the level which separates the layers to be analysed. As the cells used in the Uppsala laboratory hold comparatively long columns of solution, this condition can easily be fulfilled. A simple deduction gives the following equation for the calculation of the sedimentation constant, s :

$$s = -\frac{1}{2\omega^2 t} \ln \left(1 - \frac{2\Delta}{qxc_0} \right),$$

where ω is the angular velocity, t the time, Δ the change in amount of substance above or below the level at which the separation is made, x the distance of this level from the centre of rotation, q the cross-section area of the cell at this level, and c_0 the original concentration of the solution.

To avoid mixing the layers of the centrifuged solution when stopping the rotor, and especially when pipetting out the samples, we have divided the contents of the cell into two parts (of about equal volume in the present construction) separated by a thin wall of bakelite with a large number of fine holes, supporting a piece of hardened filter paper. The sieve plate is made in one piece with the bakelite centre part of the cell. This arrangement effectively prevents mixing for a time sufficient to remove the cell and to pipette out the contents of the upper compartment and rinse it quantitatively. On the other hand, as optical observations indicate, an arrangement including such a highly permeable membrane does not obstruct the free sedimentation. This is probably due to local convection at the membrane rapidly equalizing any small difference in density which would tend to occur as a consequence of an accumulation of material just above or dilution just below the wall. One must remember that density differences are multiplied enormously by the centrifugal force.

The arrangement may, of course, be modified in several ways according to the purpose of study; one may use several compartments and differently placed walls. The cell described here allows optical observations to be made in the same experiment, which is a great advantage.

The method should be of much value not only for the study of substances of specific activity, as mentioned above, but also for a number of other important problems. The sedimentation of substances of low molecular weight is difficult to observe optically, as the rapid diffusion prevents the boundary from leaving the meniscus completely, a circumstance without influence in the analytical procedure described. Interesting possibilities are offered in the field of mixtures of substances of different chemical nature, like carbohydrates and proteins. Separations for preparative purposes, guided by optical observations, should be possible with small quantities of material.

We have made some preliminary experiments to demonstrate the possibilities of the method. A run with carbon monoxide-haemoglobin of $c_0 = 3.4$ per cent concentration gave $s = 3.6 \times 10^{-13}$ by the method described, whereas optical observation of the boundary migration (light absorption method) gave $s = 3.56 \times 10^{-13}$. (Both values uncorrected

for the concentration influence of the carbon monoxide-haemoglobin itself.) A few experiments were made with a type 1 antipneumococcus horse serum. In the first run, the heaviest globulin component observed was completely centrifuged out of the top compartment, as judged by optical observation. Analytical measurements according to the method of Heidelberger, Sia and Kendall⁴ showed that less than 1 per cent of the antibody originally present was left in the top compartment, whereas 92 per cent was found in the bottom. (We are indebted to Dr. E. A. Kabat for making these analyses.) Centrifuge runs of shorter duration, still leaving the fastest globulin boundary above the membrane, showed a corresponding increase in the analytically determined amount of antibody in the top layer. This indicates that the antibody function is mainly connected with this heavy globulin component, in agreement with earlier findings^{2,3}.

Institute of Physical
Chemistry, University,
Uppsala. Sept. 27.

ARNE TISELIUS.
KAI O. PEDERSEN.
THE SVEDBERG.

¹ Eriksson-Quensel, I. B., and Svedberg, T., *Biol. Bull.*, **71**, 498 (1936).

² Heidelberger, M., Pedersen, K. O., and Tiselius, A., *NATURE*, **138**, 165 (1936).

³ Wyckoff, R. W. G., *Science*, **84**, 291 (1936).

⁴ Heidelberger, M., Sia, R. H. P., and Kendall, F. E., *J. Exp. Med.*, **52**, 477 (1930).

⁵ Biscoe, J., Heršik, F., and Wyckoff, R. W. G., *Science*, **83**, 602 (1936).

Absorption of Tri-brom Ethanol through the Skin

In connexion with a study on absorption of various drugs and chemicals through the intact skin of different animals, an interesting observation was made in this laboratory. It was found that tri-brom ethanol readily penetrates the intact skin of such small animals as rats and mice and produces its characteristic narcotic effects.

A solution of tri-brom ethanol crystals (Winthrop's) was made in 95 per cent ethyl alcohol. When a sufficient amount of this solution was applied to the fur of white mice, it was rapidly absorbed and the animals were anesthetized within 15-30 minutes. The anesthesia lasted 2-3 hours, after which the animals recovered. When larger doses were applied, anesthesia was followed by coma and death. The minimal quantity of a 10 per cent solution of tri-brom ethanol in 95 per cent ethyl alcohol required to anesthetize a mouse weighing 24 grams was 0.85 c.c. In control experiments with ethyl alcohol alone, no narcotic effect was produced, nor was the anesthesia described above due to absorption through the mouth.

Inasmuch as tri-brom ethanol intended for clinical use is combined with amylene hydrate, experiments were also made with a 10 per cent solution of tri-brom ethanol together with 5 per cent of amylene hydrate in 95 per cent ethyl alcohol. The minimal dose of this mixture required to produce general anesthesia, when applied to the skin of mice averaging 24 grams in weight, was 0.75 c.c. The effectiveness of this dose, which is smaller than that required of tri-brom ethanol solution in alcohol alone, is obviously due to the synergism produced by combination of amylene hydrate with the drug.

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Production of Artificial Respiration by Rhythmic Stimulation of the Phrenic Nerves

In a study of the effects of drugs on respiration, the various methods used for the production of artificial respiration were found to be unsatisfactory. In an attempt to work out a suitable method for the work, it was found that the phrenic nerves when stimulated rhythmically would carry on respiration for hours and at the same time keep the animal in exceptionally good condition.

The primary currents of two induction coils, in addition to being made and broken by their interrupter operated by the iron core, were closed and opened by a rotary contact. By means of an electric motor and rheostat, this contact was rotated slightly above the normal respiratory rate of the animal. Anesthetized rabbits were used. The phrenic nerve on each side of the neck was isolated just above its point of entrance into the chest and placed in a small shielded electrode. Each electrode was connected with the secondary of one of the induction coils. By placing a sledge key in each of the primary circuits, the action of either the right or the left diaphragm could easily be demonstrated, while changes in the rate of the motor changed the respiratory rate.

The method was found especially useful in experiments where hyperventilation was desired. It obviates the changes in circulation which result when the increased tracheal pressure method of artificial respiration is used. As conductivity in nervous tissue is poor immediately following decapitation, it was found necessary in this preparation to use another method of artificial respiration until the phrenics had sufficiently recovered.

A further study of the method with the view of extending its applications and improving the technique is being carried out.

R. A. WAUD.

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University of Western Ontario,
London, Ontario.

A Coloured Intermediate on Reduction of Vitamin B₁

A VERY distinct green yellowish colour appears when vitamin B₁ (synthetic, I. G. Farben.), in a 0.5-1 per cent solution, is reduced with hydrosulphite in the manner described in a previous note¹. The intensity of the colour is highest at the beginning, declines with the declining rate of reaction and disappears at the end. The same transient green colour is observed when the vitamin is reduced with zinc dust in normal hydrochloric acid.

Similar coloured intermediates have been observed on reduction of cozymase² and of nicotinic acidamide methyl iodide³. These compounds are considered as half-reduced pyridines corresponding to the semi-quinones of Michaelis⁴. Therefore, it is suggestive to consider the coloured reduction product of vitamin B₁ as a half-reduced thiazole.⁵

Fritz Lipmann.

Biological Institute,
Carlsberg Foundation,
Copenhagen.
Sept. 30.

¹ Lipmann, *NATURE*, **135**, 1097 (1936).

² Adler, Hellström and v. Euler, *Z. physiol. Chem.*, **242**, 225 (1936).

³ Karrer and Benz, *Helv. chim. Acta*, **19**, 1028 (1936).

⁴ Michaelis, *J. Biol. Chem.*, **93**, 211 (1931).

⁵ See also Brienmeyer, Epprecht and v. Mayenburg, *Helv. chim. Acta*, **31**, 661 (1937).

Constitution of the Poly-acids

THE work of Keggin¹ has placed the constitution of the 12-heteropoly-acids, metatungstates and metamolybdates—for example, $R_3H[SiW_{12}O_{40}] \cdot aq.$, $R_3[H_2Mo_{12}O_{40}] \cdot aq.$ —on a sure basis, and has indicated that the poly-acid anions may be regarded as co-ordination structures, built up of polyhedra of oxygen ions in the manner first envisaged by Pauling². The constitution of other groups of poly-acids, for example, those with 9 or 11 MoO_3 or WO_3 for each molecule of hetero-acid, is still quite unknown, as also is that of the second main series of poly-acids—the 6-poly-acids, such as the 6-molybdo-periodates.

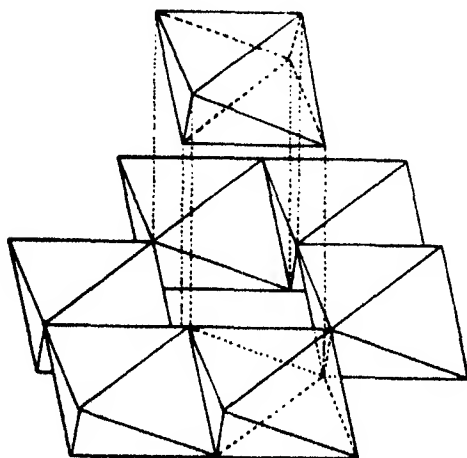


Fig. 1.

These have hitherto been regarded as satisfactorily expressed by the Rosenheim formula, $R_{12-n}[M^n(XO_4)_6]$, and there is good evidence that the central atom is, as shown, in 6-fold co-ordination. It may be predicted, however, from Goldschmidt's table of ionic radii, that the Mo^{6+} and W^{6+} ions must normally be found in 6-fold co-ordination with oxygen, as they are in known oxide structures, such as the 12-poly-acid anions. This conception leads to a new structure for the 6-heteropoly-acids and the related paramolybdates and paratungstates. It may readily be seen that six MoO_4 octahedra may be so arranged, by sharing corners with each of two neighbouring octahedra, that a hexagonal Mo_6O_{24} annulus is built up. The central cavity of this structure is then the same size and shape as one of the MoO_4 octahedra, and can therefore accommodate another cation in the same 6-fold co-ordination (see Fig. 1).

It is suggested that this is the structure of the 6-poly-acid anions. The similarity between the paramolybdates (and paratungstates) and the 6-heteropoly-acids led to their formulation by Rosenheim as $R_3H_2[H_2(MoO_4)_6] \cdot aq.$ Sturtevant³ has recently shown that ammonium paramolybdate is correctly represented by the older formula $3(NH_4)_2O \cdot 7MoO_3 \cdot 4H_2O$, or $(NH_4)_6[Mo_7O_{24}] \cdot 4H_2O$. The relation of this to the 6-heteropoly-acids, for example, to $R_3[I(Mo_6O_{24})]$, is at once made clear if the paramolybdate is regarded as $R_3[Mo(Mo_6O_{24})]$, with the Mo_6O_{24} structure built around a central MoO_4 octahedron in place of the IO_4 octahedron in the 6-molybdo-periodate.

Moreover, if some hydrolytic process, such as $[Mo(Mo_6O_{24})]^{3-} + H_2O \rightleftharpoons [Mo_7O_{24}]^{2-} + H_2MoO_4$, $[I(Mo_6O_{24})]^{3-} + 3H_2O \rightleftharpoons [Mo_7O_{24}]^{2-} + H_2IO_4 + H^+$ may be postulated in solution, it is possible that

the grave discrepancies between the X-ray evidence and the considerable bulk of physico-chemical evidence as to the complexity of poly-acids in solution might be removed.

In the present state of the subject, a careful X-ray examination of the 6-poly-acids, including the paramolybdates and paratungstates, is urgently desirable.

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Sept. 28.

¹ Keggin, F. J., *Proc. Roy. Soc., A*, **144**, 75 (1934).

² Pauling, L., *J. Amer. Chem. Soc.*, **51**, 1010, 2868 (1929).

³ Sturtevant, J. H., *J. Amer. Chem. Soc.*, **59**, 630 (1937).

Determination of the Relaxation Time for the Vibrational Energy of Carbon Dioxide

DURING the past year, we have made a series of measurements¹ on the absorption of sound in gases at ordinary and low temperatures. As is well known, such experiments are of great interest in connexion with the collision mechanism between molecules. These phenomena can also be studied by means of measurements on the dispersion of the velocity of sound. This method is followed by Eucken and his collaborators².

We investigated especially oxygen, carbon monoxide, hydrogen and nitrogen. On the other hand, Eucken has studied carbon dioxide and nitrous oxide, for the reason that for such gases the vibrational energy is great, so that dispersion measurements are easily made. Hence there was hitherto no immediate relationship between our measurements and those of Eucken.

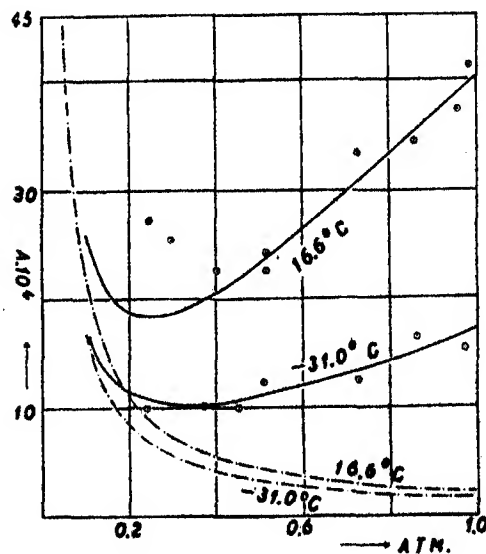


Fig. 1.

Recently we have made absorption measurements on well purified carbon dioxide, so that a direct comparison is possible with the dispersion measurements of Eucken. We have made measurements at 16.6°C. and -31.0°C., and have studied at each of these temperatures how the absorption of sound depends on pressure (frequency used, 304.4 kc.).

The results of our measurements are represented in Fig. 1. From these experimental results the following conclusions may be drawn:

(1) When we calculate the relaxation time at one atmosphere from the absorption coefficient A cm. (Kneser notation) at 16.6°C . and -31.0°C ., we find respectively $(8.3) \times 10^{-6}$ and $(13.3) \times 10^{-6}$ sec. These values agree very well with the values obtained by Eucken. He finds from his recent measurements $(8.27) \times 10^{-6}$ sec. at 19.5°C .

(2) The full lines of Fig. 1 represent the theoretical curves which are calculated for the relaxation times $(8.3) \times 10^{-6}$ and $(13.3) \times 10^{-6}$ and by supposing that the relaxation time for the transversal oscillation is the same as for the longitudinal vibration. We see that at -31.0°C . and at 16.6°C . (here only for a portion of the curve) the experimental values are on the theoretical curves.

The dotted curves of Fig. 1 correspond to the classical absorption.

(3) As under (2), the experimental values at 16.6°C . deviate from the theoretical curve in the region of small pressures. From the discussion of these deviations we have come to the conclusion that the experimental curve may be described by means of two relaxation times. An estimation of the second relaxation time gives as result $(1.7) \times 10^{-9}$ sec. A possible explanation for this very small relaxation time is an influence of the rotations. On the other hand, a serious objection to such an explanation is that at -31.0° no deviation is found.

(4) Finally, it is necessary to direct attention, as was done by Eucken, to the fact that impurities of the order of a few parts per thousand have an excessive influence on this kind of phenomenon. We believe that such facts must have a great importance relative to chemical kinetics.

The results of these experiments together with others will be published in a more complete form in *Physica*.

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¹ van Itterbeek, A., and Mariëns, P., *Physica*, **4**, 207 (1937); **4**, 609 (1937).

² Eucken, A., and Becker, R., *Z. phys. Chem.*, **27**, 219 (1934); **27**, 235 (1934). Eucken, A., and Jaacks, H., *Z. phys. Chem.*, **30**, 85 (1935). Eucken, A., and Nümann, E., *Z. phys. Chem.*, **36**, 163 (1937).

Infra-red Absorption of Carbon Disulphide

Two points of considerable interest in this spectrum have just come to light. With the view of instituting a comparison between the corresponding infra-red frequencies of gaseous and liquid carbon disulphide, the two spectra have been carefully re-examined in this laboratory. Using a prism spectrometer, we have found that the band of gaseous carbon disulphide at $11.4\ \mu$, previously supposed¹ to be a doublet with a maximal separation of 13 cm^{-1} , is really a triplet with maxima at 884 , 878 , and 870 cm^{-1} , having the appearance of a band with a medium intensity Q branch. Up to the present this band has been assigned to $\nu_2 - \nu_1$, but it is difficult to see how the triplet structure can arise from such a combination.

For information on the second point I am indebted to the kindness of the Government Chemist, Dr. J. J. Fox, and his collaborator, Dr. A. E. Martin. Some time ago, Dr. Cassie and I² explored certain of the bands with a grating spectrometer, and

resolved the $4.61\ \mu$ band into a doublet with maxima at 2175.3 and 2162.0 cm^{-1} . Doubt was thrown upon the accuracy of our results by Sanderson³, who repeated the work and found maxima at 2191.2 and 2177.9 cm^{-1} . The two observations are reconciled by the observations of Fox and Martin, who find all three peaks at 2190.2 , 2177.1 , and 2165.4 cm^{-1} , and also obtain the rotational structure. The band has generally been assigned to the combination tone $\nu_2 + \nu_1$, but may arise in part from excited levels. It is remarkable that no evidence seems to have been found for the existence of the double doublets which are such a characteristic feature of the spectrum of carbon dioxide.

With regard to the change of spectroscopic frequencies with change in state, Dr. Angus and I have found somewhat unexpectedly that in spite of the non-polar nature of the substance, there are marked shifts of the order of 30 cm^{-1} in many of the bands in the passage from the gaseous to the liquid state.

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¹ *Proc. Roy. Soc., A*, **132**, 236 (1931).

² *Proc. Roy. Soc., A*, **140**, 605 (1933).

³ *Phys. Rev.*, **50**, 209 (1936).

Colour Changes in *Hippolyte* varians

THE demonstration by Perkins¹ that colour changes in *Palrmonetes vulgaris* were controlled by a hormone that originated in the eye-stalks has since been confirmed and extended by a number of investigators (see Hånstrom's² review). Gamble and Keeble³ in their classic study of colour changes in *Hippolyte* were the first to describe a diurnal rhythm which persisted under constant environmental conditions. Within the past five years, several papers on persisting diurnal rhythms in the pigmentary system of crustaceans have appeared. The two English investigators interpreted the phenomena of crustacean metachrosis, according to the view of chromatophoral activity prevalent at that time, as being dependent upon the nervous system. We reinvestigated the colour changes of *Hippolyte* to see whether the endocrinal control similar to that found in other crustaceans was present.

It was found that extracts of crustacean eye-stalks (prepared from *Leander serratus* and from *Hippolyte varians*) when injected into test *Hippolyte* were effective in causing concentration of the chromatophores, accompanied by the diffusion of blue pigment into the surrounding tissues. Normal individuals, when kept under normal day and night conditions, exhibit the diurnal rhythm of colour change described by Gamble and Keeble, becoming "nocturnes" at night (the dark chromatophores concentrating to the punctate or stellate condition and the diffuse blue colour appearing in the tissues) and reverting to their original colours during the day. Individuals in which the retinas had been destroyed showed identical diurnal behaviour. Inasmuch as the presence of the crustacean eye-stalk hormone has been found necessary for concentration of the chromatophore pigments, we thought it might be possible to abolish the nocturnal colour phase by amputating both eye-stalks at their bases and thereby removing the source of the hormone. Gamble and Keeble had attempted to

render the eyes functionless by crushing the optic ganglia and by cutting off the eyes. We are able to confirm their results; individuals from which both eye-stalks had been removed were able to pass into the nocturnal colour phase.

The persistence of the diurnal rhythm in such preparations has been cited as proof of the existence elsewhere than in the eye-stalks of additional glandular tissue capable of liberating the chromatophoretic hormone. We believe this behaviour can be explained differently. Gamble and Keeble reported that the diurnal rhythm persisted under constant external conditions. Thus, normal as well as eyeless *Hippolyte*, regardless of whether they were maintained in constant illumination or in constant darkness, went into the nocturnal colour phase with approaching nightfall and reverted to their "diurnal" phase in the daytime. We have not been able to confirm these observations. Normal *Hippolyte*, individuals with the retinas ablated, and animals from which the eye-stalks had been removed always passed into the nocturnal phase when placed in darkness during the day. Microscopic examination of such individuals revealed the concentrated condition of the red chromatophore pigment. Within ten minutes after removal to light (on a white background) the nocturnal condition began to pass, the diffuse blue coloration having completely faded and the red chromatophores showing signs of pigment dispersion. Twenty to thirty minutes later the chromatophores had become dispersed and the animals were completely dark.

The chromatophores of *Hippolyte* can respond directly to light and to darkness, and the persistence of a diurnal rhythm under constant conditions is negatived by the results obtained from observations made during day and night on individuals maintained in darkness.

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¹ *J. Exp. Zool.*, **50** (1928).

² *Ergab. Biol.*, **14** (1937).

³ *Quart. J. Micro. Sci.*, **43** (1900).

The γ -Rays of Polonium

IN a recent note, Champion and Barber¹ have suggested that the γ -rays of radium E may arise from the production of electron-pairs by internal absorption of β -rays, the γ -rays being thus recombination radiation. It seems possible that the γ -rays of polonium² may be due similarly to the production of electron-pairs by internal absorption of α -rays. My analysis³ of the absorption curve of this radiation suggested quantum energies of (1.0 ± 0.1) and (0.4 ± 0.1) million electron volts, equal numbers of the two types (about 12 per million α -particles) being emitted. This is consistent with identification as recombination radiation, and the process is consistent with conservation of momentum and energy.

If this interpretation is correct, all members of the radioactive series that emit α -particles should also emit γ -rays of quantum energies 0.5 and 1.0 million electron volts, the intensity corresponding to a few quanta per million α -particles, since the initial energy of all α -particles is sufficient to produce pairs. Slater⁴

found, in the case of radon, that a weak γ -radiation was emitted whatever the lining of the vessel containing the gas. In the case of most of the other elements, the detection of this relatively weak radiation would be difficult on account of the presence of other, more intense, γ -rays.

It is conceivable that the radiation Slater found to be emitted when lead and tin are bombarded with radon α -particles is connected with the production of electron-pairs, the absorption coefficients being consistent with this interpretation, and the effective cross-section, 10^{-24} cm.² (upper limit), being not inconsistent with the value 10^{-22} cm.² found by Champion and Barber in the case of mercury bombarded with radium E β -particles. This interpretation does not, however, offer any reasonable explanation of the absence of a similar effect when lead and tin are bombarded with polonium α -particles.

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¹ *NATURE*, **140**, 105 (1937).

² Bothe, W., and Becker, H., *Naturwiss.*, **18**, 894 (1930).

³ *Proc. Roy. Soc. A*, **136**, 428 (1932).

⁴ *Phil. Mag.*, **42**, 904 (1921).

The Function of Experiment

IN continuing to maintain that stringent experimental test of a theory of Nature is pedantic, Mr. Whitrow would appear to be more extreme in his views than are most of the contributors to the symposium on physical science and philosophy¹. Prof. Milne, for example, states that "the relevance of the theorems to Nature would require to be established by observation"². When Mr. Whitrow persists in claiming the support of Galileo³ on the grounds of his (Galileo's) profession of readiness to accept his own theories⁴, he displays an imperfect understanding of the nature of experimental demonstration.

A complete and self-contained experiment must do two things. It must provide a measure of some quantity for comparison with a theoretically predicted value, and it must provide data from which we may calculate the likelihood that any observed discrepancy might be exceeded by chance. When the level of significance of the results is thus calculable from the experiment itself, we are each of us in a position to interpret the experiment without appeal to authority, to reject it or to accept it according as we are difficult or easy to satisfy. Other things being equal, a great number of experiments affords a more sensitive test of a theory than does a few; that is, it is possible to discern smaller 'real' discrepancies against the background of chance variation. It is clear that without experiment, or with only one experiment, it is impossible to estimate 'experimental error'.

Now, it may be that a series of experiments is too meagre to provide within itself an acceptable test of theory, and yet the experimenter may accept it in the light of past experience. He is then, in effect, calling upon past experience to furnish him with a rough estimate of variance⁵. He might even, upon rare occasions, justify himself in accepting theory without test on no better grounds than that he is customarily right ninety-five or ninety-nine times out of a hundred. The general acceptance of this

assertion of his authority must depend upon the extent of his experience and his unquestionable integrity, of which he himself is the only competent judge. He must therefore aim at providing a high level of significance, even though he may upon occasion be justified in not requiring it for his own satisfaction.

It is not obvious why we should suppose that Galileo meant anything more profound than this. He merely expressed confidence in his own judgment, yet he made no assertion of authority but carried out the experiments which he would undoubtedly have demanded of others. It may be pointed out, in conclusion, that to accept one's own theories without adequate test and without a long record of sound judgment is to plead guilty of a very human weakness.

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¹ NATURE, 139, 1008 (1937).

² NATURE, 139, 997 (1937).

³ NATURE, 140, 646 (1937).

⁴ Fahie, W. C., NATURE, 140, 646 (1937).

⁵ Fisher, R. A., "The Design of Experiments", p. 39 (Oliver and Boyd).

Relation between Body Size and Metabolism

SINCE 1935, work has been proceeding on the respiration of different genotypes of *Drosophila melanogaster* during the first hours of the puparial period. The work has now been completed, and a

full account will shortly be ready for publication. For the moment, however, it may be said that differences in oxygen uptake per mgm. body weight originally found between the sexes and between the *wild-type* and its mutant *vestigial* were later shown to be due to slight differences in the sizes of these animals; when these were eliminated by alteration of the culture conditions the metabolic differences also disappeared. By actual measurement of the surface area of puparia it was further shown that the surface area per mgm. decreased, with increasing body size, at the same rate as did the oxygen consumption per mgm., and that the oxygen consumption was therefore related to the surface area.

Further work is in preparation which will indicate whether this relationship can be extended to other groups of animals, and will also help, it is hoped, to establish the causal nature of the connexion between body size and metabolism. Results already obtained clearly show the necessity, in metabolism experiments on cold-blooded animals, of paying much more attention to body size than hitherto; it is possible that the latter may prove to have considerable importance in problems of an ecological nature.

Using surface area as a standard, it is intended to investigate possible metabolic differences between the various species and races of *Drosophila*.

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Points from Foregoing Letters

IRREGULAR echoes of radio waves reflected from heights between 100 km. and 300 km. indicate, according to T. L. Eckersley, the presence of ionic clouds or irregularities in the ionosphere. Since the effect is noticeable both day and night, the sun cannot be responsible for this ionization, and it is suggested that the responsible agents might be small meteorites or high-speed particles from the stars.

A. Tiselius, K. O. Pedersen and Prof. T. Svedberg describe a new procedure for the quantitative study of ultracentrifugal sedimentation. With a specially modified cell, the centrifuged solution is separated into two portions, each of which can be readily pipetted out and analysed. From the change in the amount of the sedimenting component in one of the layers the sedimentation constant can be calculated. The method is of special importance in the study of substances like enzymes and antibodies, and may also be useful for measurements on very slow sedimenting molecules.

Dr. D. I. Macht finds that tri-brom ethanol in ethyl alcohol solution is rapidly absorbed when applied to the skin of mice, and produces its characteristic anaesthetic effect. The presence of amylene hydrate in the solution helps to produce the narcosis more rapidly.

Prof. R. A. Waud reports that he has been able to carry on artificial respiration in the rabbit by rhythmic stimulation of the phrenic nerves.

The appearance of a transient greenish-yellow colour on reduction of vitamin B₁ has been observed by F. Lipmann, who assumes that it is due to the formation of a semiquinone-like product.

From considerations of atomic radii, Dr. J. S. Anderson arrives at a possible structure for 6-polyacids (such as the 6-molybdo-periodates). To account for discrepancies between the evidence obtained from X-ray investigations and from physico-chemical evidence he suggests that the 6-polyacids may be hydrolysed in solution.

The absorption of sound in purified carbon dioxide gas at various pressures up to 1 atmosphere, and at temperatures of 16.6° and -31° C., has been determined by Prof. A. van Itterbeek and P. Mariëns. The authors calculate the relaxation time for the vibrational energy (of importance in connexion with the collision mechanism between molecules) and compare the values obtained with those calculated from measurements of sound dispersion. Small amounts of impurities exert considerable influence.

C. R. Bailey reports that the infra-red absorption bands of carbon disulphide at 11.4 and 4.6 μ have three components. Although carbon disulphide is a non-polar substance, shifts in some of the absorption bands have been observed on passing from the gaseous to the liquid state.

Drs. L. H. Kleinholz and J. H. Welsh confirm the fact that extracts of eye-stalks from the Crustacean *Hyppolyte varians* when injected into living specimens (which show diurnal change of colour) produce darkening due to diffusion of blue pigment. They find, however, that specimens which had their eye-stalks removed and were kept in darkness, responded to light at all hours; hence they consider that light acts directly upon the colour-producing mechanism and not necessarily by a hormone.

Research Items

The Marriage of Osiris

In a study of the origins and character of the Osirian ritual in Egyptian religion, Mr. G. D. Hornblower (*Man*, Oct. 1937) figures a sculptured scene from the inner chamber attached to the Hall of Sukkur (Sokkaris) in the temple of Seti I at Abydos, which depicts the culminating scene of the great rite of the latter half of the month of Hathor, which in the Egyptian calendar is the last of the four months of the Nile flood. In the process of synthesizing the various local cults of Egypt, Osiris came to be identified with the Nile flood (but not with the river), while Isis became Mother-Earth, the flood appearing as a kind of hierogamy or sacred marriage. The sculptured relief at Abydos puts Seti, the king, in special relation with the god at the supreme moment of the adventures in the myth of Osiris. Osiris is here seen lying as a mummy in the "House of Sukkur", that is, the tomb. At his head is his sister-wife Isis, the Great Lady of Magic, who is engaged in calling her dead husband back to life, temporarily, for the purpose here revealed. For Isis, in accordance with the principle of early art, which depicts succeeding events in the same plane, is also shown in the form of a falcon, with her name inscribed by her, hovering over the body of Osiris, who, now resuscitated, is seen in the act of fecundating her. The rite is thus revealed as the solemnization of a sacred marriage. At the feet of Osiris, Horus, the falcon-god, stands protectively, and a falcon also shelters the head of Osiris. This is undoubtedly the outstanding rite of the Egyptian year. Other sacred marriages are known—of Amun-re at Thebes, in the "Festival of Opet", and of Horus and Hathor at Edfou. It appears that a sacred marriage was a very early general institution which was adapted to Osiris on the establishment of his cult, the festival being observed concurrently in various Egyptian towns.

Early Indian Sites in Virginia, U.S.A.

An examination has been made of a number of ancient Indian sites in the State of Virginia, U.S.A., by Mr. David I. Bushnell, jun. (*Smithsonian Miscell. Collect.*, 96, 4). These sites have been discovered on the banks of the Rappahannock, beginning at Leedstown, an early colonial settlement some forty miles below the falls, and continuing up the valley. The finds—stone implements, potsherds, beads and clay pipes—are from the surface, and probably represent the midden material from village sites, which have been scattered by the plough. Further research by excavation is eminently desirable. When the English first explored the Rappahannock, they found many Algonquian (Nandtaughtacund) villages in this district, extending up to the large island below the falls near the present city of Fredericksburg. From this point, the territory extending westward belonged to the Manahoac, a Siouan group constantly at enmity with the Algonquians. The finds of the present investigation vary in form and material, and obviously belong to several distinct periods of occupation. They prove that the tribes encountered by the settlers were not the first to

inhabit the country; and indeed it is evident not only that this area was occupied and re-occupied for centuries, but also that a part of the valley below the falls had been abandoned by the Algonquian tribes in 1608 when it was first visited by the English. The occurrence of a beautiful Folsom point of the eastern type near the Millbank creek on the left bank represents an interesting problem, which requires further investigation in order that the evidence of stratification may be made available for the consideration of the antiquity of man in the eastern States. Next in importance to the Folsom point are two axes found above Lamb Creek, which resemble a specimen found some years ago on the Rapidan. These may be earlier than the Algonquian occupation. Argillite points and scrapers resemble those from the Delaware Valley, and may also be pre-Algonquian.

Breeding of Oysters in Tanks

Mr. H. A. COLE has gone a long way towards solving the problem of oyster breeding in captivity for the improvement of the oyster industry ("Experiments in the Breeding of Oysters (*Ostrea edulis*) in Tanks, with special reference to the Food of the Larva and Spat. Min. Agric. Fish. Fish. Invest. Series 2, 15, No. 4; 1936). His own experiments during 1936 are particularly described, but these are a continuation of the work of Dodgson and Sherwood from 1919 onwards. It was found in 1918 that a large amount of spat from oysters which had remained in the tanks following some purification experiments had settled. The same occurred during the next two years, and in 1921 an attempt was made to repeat the spat collection on a much larger scale with the view of possibly re-stocking the natural beds. The results showed that food for the young oysters, especially in the free-swimming stage, was all important, and laboratory experiments were specially made to find a good micro-organism on which the free-swimming larva could be fed. These experiments show that the only food which the oyster in its free-swimming existence is able to use is the naked flagellate, and that only the settled spat can feed on green cells surrounded by a cellulose or hemi-cellulose cell wall. The explanation put forward is that the slow penetration of enzymes through such a cell wall during the passage of food through the gut is possible in the spat, but in the larva where the passage is very rapid the cells pass through undigested. In the large-scale experiments where two tanks were used, one was provided with finely divided organic material and the second was used as a control, the result showing a much larger number of larvae which settled in the tank so manured whilst the flagellates were also much more numerous. It is now possible to anticipate with some confidence a spat-fall of commercial value in the tanks, the rapid growth of such spat transferred to cages in the open water showing that the methods employed are effective. Good results are anticipated from further experiments in culturing on a large scale the naked flagellates for the food of the larvae.

Climatic Cycles and Tree Growth

PUBLICATION No. 486 (1937) by the Carnegie Institution of Washington contains a description by W. S. Glock of the principles and methods of tree-ring analysis developed by Dr. A. E. Douglass, which enters very fully into the methods of sampling trees and of reading and correlating the numbers and breadths of the annual rings. A survey of ring breadths at different heights on the trunk of *Pinus ponderosa*, which extended even to observations on branches and roots, supplies convincing evidence of the validity of these ring measurements, and the analysis of the correlation between these observations and examination of their value as climatic indicators show how carefully and conservatively the new technique is being developed. Mr. G. A. Pearson, senior sylviculturist in the United States Forest Service, discusses the factors influencing the growth of trees, but those have received more adequate treatment in many forestry publications; this volume will rather be consulted for its very full account of the technique developed in reading the ring breadths of trees and in applying such data to the discovery and analysis of climatic cycles.

Fjord Formation

THE coastal mountain belt of North-East Greenland affords ample evidence of a former considerable ice-cover, and the extensive system of fjords in that region provides scope for the study of the origin and development of fjords in relation to erosion processes. Mr. N. E. Odell discusses this problem in a paper on the Franz Josef fjord region of North-East Greenland in the *Geographical Journal* of August and September. J. H. Bretz, in a former study of these fjords, considered them to be stream-eroded valleys modified and deepened by ice action, which would, he believes, be accentuated, during ice submergence, on a previously eroded valley. This was also the view of F. Nansen. Mr. Odell, on the other hand, considering in detail the possibilities of subglacial plucking, doubts the ability of the ice to do the work suggested. An ice-sheet covering a steep preglacial valley might possibly have the motion necessary for abrading, but would be unlikely to acquire moraine matter, without which the scouring action would not occur. Mr. Odell also shows that the disintegrating effects of basal freeze and thaw would probably be absent. On this and other evidence he inclines to the belief that the greater part of the fjord formation of North-East Greenland must be attributed to a period of partial and complete emergence of the land surface rather than to a time of entire submergence by continental ice.

Basalts from the Carlsberg Ridge

AN important contribution to the petrology of the floor of the Indian Ocean has appeared (*Sci. Rep. John Murray Exped., 1933-34, 3, No. 1, 1-30, British Museum, 1937*). Dr. J. D. H. Wiseman gives petrographic descriptions and chemical analyses of four Carlsberg Ridge rocks dredged from a depth of 3,385 metres. While mostly angular, some of the specimens are rounded and have a coating of manganese nodule material. Three of the analysed rocks are oligoclase-basalts; the other is hornblende-augite-dolerite. Chemically, all are characterized by low total iron, relatively high soda and very low potash, and thus show spilitic affinities. The possibility that the unique alkali relations may depend

on the action of sea-water is discussed, but it is concluded that they are much more probably an index to the nature of the parental magma. The rocks are chemically different from the Deccan traps and other Gondwanaland basalts, and there is strong evidence that they are of submarine origin and do not represent sunken remnants of any former land area. Apart from the very low potash contents, the Carlsberg Ridge specimens are comparable with average basalts from the Atlantic and Pacific Oceans, all of which differ from the Plateau basaltic types of the world in their lower iron contents. Dr. J. H. J. Poole has determined radium in the described specimens and finds the amounts present to be uniformly low, in which respect the rocks also differ systematically from the Deccan basalts.

Deep-Focus Earthquakes in the South-West Pacific

MR. R. C. HAYES has recently made an interesting study of the distribution of normal and deep-focus earthquakes in the south-west Pacific (*Bull. N.Z. Dom. Obs. Wellington, No. 109, 691-701; 1937*). The area considered is bounded by the parallels 0° and 50° S. and the meridians 140° E. and 160° W., and, during the years 1918-34, contains the epicentres of 87 deep-focus earthquakes, of which Mr. Hayes gives a valuable catalogue. These form 11 per cent of the total number of earthquakes recorded in the district. As a rule, the focal depths lie between 100 km. and 200 km.; but, in an area of which the centre is in lat. 25° S., long. 176° E., depths of 500 km. or more were common, while normal earthquakes were almost absent. In the zone between 10° and 30° S., in which the deep-focus earthquakes were most numerous, the maximum monthly number occurred in August.

Atmospheric Pressure at Mauritius

PUBLICATION No. 18 of the Royal Alfred Observatory, Mauritius, by M. Herchenroder, is entitled "The Atmospheric Pressure at Mauritius". It is a discussion of fifty-six years' continuous record of that variable at the observatory at Pamplenoisses made with a Kew barograph recording photographically. Mean yearly values for each year from 1875 until 1930 range from 1,008.70 mb. in 1916 to 1,010.82 mb. in 1880, the mean for the whole period being 1,009.69 mb., and show a secular drift. If this drift is a cyclical variation, the period of 56 years is too short to determine its value directly, but it is held to be connected if not identical with a long-period rainfall oscillation that seems to have completed one cycle between 1872 and 1928. Short-period oscillations are superposed on the long-period oscillation, notably periods of nine and seventeen years. The annual variation is shown by plotting the means for each day of each month, and is composed mainly of a very well marked annual wave of 10 mb. amplitude with a minimum on February 9-10, which falls very nearly at the time of the maximum of the annual temperature wave. The diurnal variation is studied by means of harmonic analysis, and this shows that by far the largest component is the 12-hour cycle, the phase of which shifts slightly in the course of the year; that the next in importance is the 24-hour term (mean amplitude 0.394 mb. compared with 0.953 mb. for the 12 hour); that the 8-hour term, although its amplitude is not more than a quarter of that of the 12-hour term even at the seasonal maximum of the 8-hour term in July, shows a large and remarkably systematic double annual

variation both of amplitude and of phase; and lastly, that the small 6-hour term also shows a double seasonal variation but with phase reversed. The lunar daily variation is not determined here, having already been investigated for the forty years 1876-1915 by Chapman.

Synthesis of Vitamin B₁

THE structure previously proposed for vitamin B₁, based on the identification and synthesis of several disintegration products (notably 4-methyl-5-β-hydroxyethylthiazole, 2,5-dimethyl-6-aminopyrimidine, 2-methyl-6-oxo-pyrimidine-5-methylene sulphonic acid) and the establishment of the mode of linkage of the two nuclei indicated by the presence of quaternary nitrogen in the molecule, has been completed by J. K. Cline, R. R. Williams and J. Finkelstein (*J. Amer. Chem. Soc.*, **59**, 1937) by a synthesis of the vitamin by a method depending on the conversion of a 5-ethoxy-methyl-pyrimidine into the corresponding 5-halo-methyl derivative. Difficulties in obtaining crystalline material were encountered. Ethyl sodioformyl-β-ethoxypropionate was condensed with acetamidine hydrochloride in alcohol with sodium, and the resulting 2-methyl-5-ethoxymethyl-6-oxypyrimidine liberated and sublimed in high vacuum. This was converted into the corresponding chloropyrimidine with phosphorus oxychloride, and this into the corresponding aminopyrimidine by heating under pressure with alcoholic ammonia. By heating this with a solution of hydrobromic acid in glacial acetic acid, 2-methyl-5-bromomethyl-6-aminopyrimidine hydrobromide was obtained, and by heating this with 4-methyl-5-β-hydroxyethylthiazole in butanol and diluting with boiling ethanol, needles of vitamin B₁ bromide hydrobromide were obtained. The physiological activity of this compound, C₁₃H₁₇ON₄SB₁·HBr·0.5 H₂O, was found to be equal to that of the natural vitamin. The corresponding chloride hydrochloride was prepared, and its physiological activity established.

Structure of Carbon Suboxide

ABOUT four years ago the structure of carbon suboxide (C₃O₂) was shown by the methods of electron diffraction to be most probably linear and symmetrical. Evidence supporting this view was also derived from investigation of its ultra-violet spectrum and, more recently, from its Raman spectrum. For a molecule possessing a centre of symmetry, spectroscopic selection rules forbid the appearance of Raman-active fundamental frequencies in the infra-red spectrum and vice versa. A paper of Drs. R. C. Lord and A. Wright (*J. Chem. Phys.*, **5**, 642; 1937) on the infra-red spectrum is therefore full of interest. They find that Raman-active frequencies are not present in their spectrum and the linearity and symmetry of the molecule are now convincingly proved. The modes of vibration of such a model consist of 4 non-degenerate (2 Raman-active, 2 infra-red active) and 3 doubly degenerate (only one of which is Raman-active) frequencies. By assuming the type of molecular force field, values of the frequencies can be calculated, and it is found that one of the infra-red active degenerate fundamental frequencies lies beyond the limits of their spectrograph at about 50 μ (200 cm.⁻¹). The other degenerate infra-red fundamental (ν₂) cannot at present be assigned with certainty. From a consideration of the allowed binary and ternary com-

bination tones, there is strong indication that its value is 550 cm.⁻¹, although another possible value at 900 cm.⁻¹ cannot be completely excluded. It is interesting to note that all the observed bands can be satisfactorily interpreted on the basis of ν₂ = 550 cm.⁻¹, but further and more detailed experimental data on the infra-red spectrum, especially between 2 μ and 7 μ, between 11 μ and 18 μ, and around 50 μ, must be forthcoming before the final assignments can be made.

Atomic Weight of Phosphorus

ASTON has shown that phosphorus is a pure element, in the sense that it is composed of one type of atom only, of mass number 31. It has a negative packing-fraction amounting to -5×10^{-4} . Hence the atomic weight of phosphorus should be less than 31, especially as the factor for converting physical atomic weights to chemical atomic weights on the scale O = 16 (1.00022) also acts in the same direction. Yet the internationally accepted value for the atomic weight of phosphorus is 31.02 (O = 16). The value calculated by Aston from mass-spectrographic data is 30.978. Hönigschmid (*Naturwiss.*, **25**, 670; 1937) has recently carried out a careful chemical determination of the atomic weight of phosphorus using phosphorus oxychloride, POCl₃. The ratio POCl₃:3Ag was determined by a nephelometric method, and the value obtained for the atomic weight was 30.978, in exact agreement with Aston's result.

Effect of Surface Treatment on Magnetic Permeability

IN a letter in NATURE of May 29, Dr. T. F. Wall gave particulars of results obtained in an investigation on the permeability of nickel wire as affected by a coating of 0.003 inch of electro-deposited copper. These showed that, as compared with the bare wire, a value about 60 per cent higher could be obtained under the conditions described. The results of further tests on similar lines are now available (*Engineer*, Aug. 13), and bear out the idea which gave rise to the experiments. The dissymmetry of the molecular forces at and near the surface of the bare wire suggested to Dr. Wall a corresponding dissymmetry of the magnetic forces, and his idea was that by coating the surface with a thin skin of non-magnetic metal this condition might, to some extent, be eliminated and that interesting information might be forthcoming as to changes in magnetic properties. The later tests have been made on wire of bright drawn Armco iron with coatings of copper, nickel, and aluminium. While the uncoated wire gave a maximum permeability of 3,500, the figures reached with the coated wires were: copper coating 3,800, nickel 4,050, and aluminium 4,300. The effects are thus not as striking as in the first tests, but from the very marked increase obtained when nickel is coated with copper—two metals standing next to each other in the atomic number series—it is inferred that iron with a coating of manganese—two similarly placed metals—may be expected to show an equally pronounced increase. This is now under investigation by the methods described and with the aid of X-ray spectrograms of the boundary surface of the wire and the applied skin, and it is anticipated that in the results some light may be thrown on the behaviour of manganese in the Heusler series of alloys and its influence in Hadfield's non-magnetic manganese steel.

Origin of Oil

THE United States Geological Survey and the American Petroleum Institute have, during the course of studies of source beds, amassed a wealth of data which may prove invaluable in the elucidation of the vexed problem of the origin of petroleum. Dr. P. D. Trask has made full use of this data, and in a recent paper (U.S. Department of the Interior, Prof. Paper 186--H) he explains inferences he has drawn, and suggests that they are worthy of the consideration of geologists interested in the problem.

Geological conditions under which petroleum is found point to its derivation chiefly from the organic matter of fine-grained marine sediments. The source of this organic matter is directly traceable to planktonic organisms in the overlying water. During their life, prior to burial in sediments, these plankton undergo successive chemical changes, and a study of these provides a valuable clue as to the constitution of the organic matter of sediments.

The main source of original organic matter is floating plant life which serves as food to the animal life of the sea. On being taken in as food, part of the plankton is assimilated in the tissues of the consuming organism, part is excreted as waste, and the rest is used to generate energy. That part which generates energy is destroyed during the process. The part which is excreted may again serve as food to some organisms, but it becomes successively less and less digestible. Ultimately there remains a complex residue of substances resistant to decomposition, and, broadly speaking, this forms the organic constituents of sediments. After burial, this residue is associated with little if any free oxygen and, therefore, is unlikely to undergo much further alteration.

The average composition of marine plankton is approximately 24 per cent protein, 3 per cent fat, 73 per cent carbohydrates and other non-nitrogenous substances. The composition of the organic constituents of recent sediments is of the order of 40 per cent protein, 1 per cent fat and less than 60 per cent carbohydrates and other compounds. In ancient consolidated sediments, proportions are about 27

per cent protein, 1 per cent fat, and more than 60 per cent other compounds.

It is improbable that any substance present in organic constituents of sediments only in quantities of 1 per cent or less is a major source of oil. Cellulose is discredited on this count, since it is ordinarily found in recent sediments in amounts of 1 per cent or less. Other carbohydrates such as hemicellulose, starches and sugars, are found in equally small quantities and are accordingly discounted.

Proteins, since they form approximately 40 per cent of the organic matter of recent sediments and 27 per cent of that of lithified sediments, are possible sources of oil. The proteins in sediments, however, differ considerably from proteins of the original plankton whence they are derived. Simple proteins are present in recent sediments in such small quantities as to preclude their consideration as source materials.

Fats, though believed by many to be the chief sources of petroleum, are possibly not so, partly because they are present in insufficient quantity, and partly because they are unsaturated in character while the fats of petroleum are saturated.

In any event, cellulose, carbohydrates, simple proteins and fats together only form about 5 per cent of the organic constituents of sediments, and it is more probable that the remaining 95 per cent, or part of it, is responsible for the formation of petroleum. This is in point of fact an unassimilable residue composed of complex compounds deficient in oxygen. The tendency of buried organic constituents to come to chemical equilibrium might cause the generation of liquid hydrocarbons. These in turn might dissolve organic substances, and the resulting organic constituents in solution might react upon one another in order to reach a state of equilibrium. Repeated readjustments of this character might possibly result in the formation of petroleum.

To substantiate this hypothesis, however, detailed investigations of the chemical nature of the organic constituents of sediments are essential. Conclusions may then be reached as to the particular type of organic material likely to be transformed into oil by chemical reactions of the type envisaged.

Studies of Metals and Alloys

OF the papers read or taken as read at the Autumn Meeting of the Institute of Metals at Sheffield on September 6-9, the following short abstracts of some of the more generally interesting will give an indication of the widely varying fields of research considered.

In view of the engineering importance of alloys, both ferrous and non-ferrous, which consist of two phases of appreciably different hardnesses and of inclusions in metals generally, a paper by Hermann Unkel, on the deformation of the macrostructure of some two-phase alloys by cold-rolling, is welcome. Although this is but the first stage in the con-

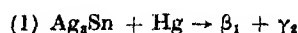
sideration of the subject, the paper gives much interesting data, and cannot fail to arouse the interest of metallographers generally.

Inverse segregation, that is, the segregation of components in an alloy in the reverse direction to that which would normally be expected, is a matter of both academic and practical importance. N. B. Vaughan contributes a general review of the present position, together with an extensive bibliography which will be widely appreciated.

The transformation which occurs at a temperature of about 470° C. in the β -brass and which has been known now for some forty years, is dealt with

in a paper by C. Sykes and H. Wilkinson. The work of Bragg and Williams which attributed the transformation to a change from disorder to order in the lattice is now generally accepted. The present paper provides data which confirm this view, and represents a most valuable contribution to our knowledge of this and similar changes in other metallic alloys.

The academic interest and the practical importance of the volume changes which occur during the hardening of a dental amalgam provide ample justification for two papers by Dr. Marie L. V. Gayler on the constitution of the alloys of silver, tin and mercury and on dental amalgams. The author concludes that the changes taking place on the setting of such an amalgam are to be attributed to complex reactions which probably do not proceed to completion and which may be briefly summed up as:



No explanation for the marked contraction or expansion which occurs is obtainable from X-ray analysis, but the former is ascribed to the formation of a solid solution of mercury in Ag_3Sn .

In view of the enormous amount of galvanized iron and steel now being used, a critical paper by L. Kenworthy on the methods of testing zinc coatings will arouse wide interest. The value of such protective coatings on iron and steel depends on the average weight, the uniformity, structure and porosity, and under these four headings the various methods which are actually in use, or which have been proposed, are described, together with their respective advan-

tages and limitations, and, in certain cases, with suggested modifications.

The determination of alumina in metallic aluminium is a matter of very great difficulty, and a paper by G. B. Brooke and A. G. Waddington makes a substantial contribution in this difficult field of metallurgical analysis. A method is described which has proved superior to any yet proposed for determining alumina in granulated aluminium dross. The complete separation of the metal by volatilization as the chloride in pure hydrogen chloride and subsequent conversion to oxide allows the metallic content to be accurately determined.

It was observed by Hopkinson in 1905 that stresses greatly exceeding the normally accepted values of the tensile strength could be applied to iron and copper wire for very short intervals of time without rupture, and this is now generally believed to hold for all the more common engineering materials. D. W. Ginns describes apparatus in which samples of metals have been broken in 0.005 sec., the yield point being attained in 0.001 sec. It is shown that when compared with ordinary tensile test values the yield point is increased very considerably, at times by more than 100 per cent, that the maximum stress is raised, but to a smaller extent, while the ductility remains more or less unchanged. It is a curious feature of many of these ultra-rapid tests that the yield point and maximum stress coincided, even in metals of high ductility. As a sample of the type of results obtained, the following may be quoted for a steel containing 0.15 per cent carbon. The tensile strength broken at ordinary rates was about 32 tons per square inch, which was raised to 37 tons in the high-speed tests. The corresponding values for the yield point were 22.3 tons per square inch and 37 tons per square inch. F. C. T.

The California Sardine and its Fishery

THE California sardine (*Sardinops caerulea*) is caught by small motor-boats using purse-seines and round-haul nets with large bunts, called 'lamparas'. The fishery takes place in autumn and winter. The California State Fisheries Laboratory has recently added two more papers to the series of studies of this fishery.

The first paper ("Interseasonal and Intra-seasonal Changes in the Size of the California Sardine (*Sardinops caerulea*)"). By Frances N. Clark. Contribution No. 150 from the California State Fisheries Laboratory) deals with the results of the biometrical investigations which have been carried on by the staff of the State Fisheries Laboratory during the last sixteen years. The autumn fishery is of adolescent fish which will spawn for the first time in the following spring, and of the three preceding year groups. In the winter fishery these young fishes continue to be caught, but the bulk of the catch is made up of fishes in their fifth to tenth spawning seasons.

Unusually successful year classes occur at irregular intervals: the study of their effect upon the length frequency polygons of the autumn fishery indicates that the adolescent fishes form a higher proportion of the catches in the southern part of the area (San

Pedro-San Diego) than farther north off Monterey and San Francisco. These large year classes may be detected in the winter fisheries for six or more seasons. The author points out that the autumn fishery draws upon three or four year groups only, as against the eight or ten year groups present during the winter fishing. From the fact that the large year groups of 1929-30 and 1933-34 lost their dominance in the catches more rapidly than the year groups of 1919-20, 1922-23 and 1925-26, the conclusion is drawn that there is a considerable over-fishing of the young fish, and that a serious reduction of the sardine population must be the result.

The seasonal changes in size which occur suggest that the young fishes are to be found off the southern coast of California, and that as they grow older they tend to move farther north after each spring's spawning, so that the oldest fishes inhabit the most northerly part of the range. These old fishes move southward to the spawning grounds.

The fishing grounds of the Californian sardine boats are briefly reviewed in a separate paper ("Fishing Localities for the California Sardine, *Sardinops caerulea*, 1928-1936"). By Frances N. Clark. Contribution No. 158 from the California State Fisheries

Laboratory). In Central California practically no catches are made outside the 100-fathom line. Off Monterey, where the continental shelf is narrow, 81 per cent of the catch of sardines is taken within five miles of the coast. The shelf is wider off San Francisco,

and correspondingly more catches are made at greater distances from the shore. In southern California, where the 100-fathom line is close to the shore, the fish appear to be concentrated along the steep slope, which drops rapidly to 500 fathoms.

Lubrication and Lubricants*

INDUSTRIAL APPLICATIONS

The third group of papers is concerned with industrial applications of lubricants. Catterall and Maitland survey the use of grease in a number of diverse applications, and several papers reveal the extent to which this form of lubricant is being used. Although, as mentioned by Cooper, lubrication by an oil mist would be ideal for ball, roller and needle bearings, they are most commonly lubricated with grease, because grease remains in the housing and affords protection against dust and moisture, which would lead to abrasion and pitting of the accurate surfaces. Cooper, Richardson and Kjerrman all emphasize the undesirability of overfilling the housings, on account of churning, and the care required in choosing greases, advocating an actual running test. Hancock deals with the friction of ball and roller bearings.

Water-grease emulsions are used in drawing steel tubes (Catterall and Maitland). In the similar operation of cold pressing sheet steel, high pressures are encountered, and Arrowsmith reviews the desirable qualities of the lubricant, film strength, appropriate friction, ease of spreading and of removal, etc.; a fatty oil emulsion containing chalk powder is generally used. High pressures also occur in wire-drawing, and Goodacre states that the lubricant used in dry drawing is a dry sodium soap, in conjunction with some calcium hydroxide remaining after neutralizing the acid used in cleaning. In wet drawing one of the essentials is the formation of a very thin coat of copper or tin on the surface of the metal; the bath usually contains a fatty lubricant and soap, and must contain sulphuric acid. Thompson considers that the friction in the die is of the boundary type, and investigates a number of soaps and liquid lubricants at various temperatures.

Miller contributes a useful review of extreme pressure lubricants as regards composition and the behaviour in various testing machines, and the problems presented by the need for stability, absence of corrosion, etc.; he refers to future trends and the need for more research, emphasizing the important effect this work on additions to lubricants is having on lubrication generally. Evans gives results of tests in the Almen machine on various oils and greases, and of a number of pure organic compounds in small proportion in mineral oil. Clayton describes the superior behaviour of extreme pressure oils over other gear oils in the 4-ball apparatus, not only in breakdown load and wear, but also in the time to recovery from seizure.

Parker writes on the lubrication of bearings of light mechanisms in which the oils sometimes cannot be renewed during the life of the mechanism. High 'oiliness' has thus been regarded as important, and dolphin and porpoise jaw oils have been used; on

account of the oxidation and gumming of these oils, however, mineral oils are now being tried. Stott and Shotter agree that the pivot and cupped-jewel bearing can run well for a time without lubricant, but that oil is necessary for prolonged running at low friction, one of the important functions of the oil being to carry in suspension the iron oxide formed at the contact under the extremely high local pressures.

Hogan, also Nixon and Jackson, describe the difficult problem of lubricating wire ropes; two functions are required of the lubricant: (1) to prevent corrosion; (2) to reduce the friction and prevent seizure of the wires, which make contact with each other at high pressure. Merritt gives much useful information on gear tooth failures and on factors governing the choice of lubricants for gears; Tuplin describes the different methods of applying the lubricant. Blok, in a notable paper, shows, by Bowden's method, the high temperatures reached by gear tooth surfaces under high-pressure running conditions.

PROPERTIES AND TESTING

The fourth group of papers concerns properties and testing and is of especial interest. In connexion with boundary lubrication, Adam and Kyropoulos review surface phenomena and the function of the adsorbed boundary layer in protecting the metals from cohesive contact. Kyropoulos favours internal molecular mobility rather than elasticity as the explanation of the efficacy of long molecules; also he reasons that the lattice forces of the adsorbing surface ultimately control the lateral packing of the molecules of the boundary layer, thus accounting for the surviving influence of the surface at distances exceeding the range of the original surface forces.

Finch and Zahoorbux describe their work on electron diffraction to show orientation of surface films. Trillat studies adsorption by measuring the rate of change of oil-water interfacial tension by a modification of du Noüy's method. Using oleic acid-B.P. paraffin mixtures to provide a scale, the activity of commercial oils can be expressed in equivalent oleic acid content. Examination of an oil before and after passing it over metal balls, through filter paper, etc., shows the adsorption of active molecules at the surfaces. Miss Nottage reports results of static friction tests with fatty acid and wax additions to oils, revealing the effect of atmosphere and adsorbing surface. Fogg describes kinetic friction tests with an oscillating bearing machine; he considers that true boundary friction is obtained below 3 cycles per minute.

Surface finish in relation to the boundary layer is mentioned in a number of papers. Bowden refers to the high temperatures found at sliding contacts; with Leben he shows that sliding is a discontinuous

*Continued from page 816.

process, and that when slip occurs there is a momentary jump in temperature. Blok works out the temperature rise for sliding contacts for a number of ideal cases. Neely describes simultaneous friction and wear measurements and shows that the wear-reducing value of addition agents may be quite different in degree and sometimes in direction from the friction-reducing value. Brownsdon, Southcombe, Wells and Waters, Clayton and van der Minne report breakdown loads and wear under relatively severe conditions, and provide a fund of information relating to 'oiliness' and extreme pressure effects which can only be partially co-ordinated; it appears that the good qualities of extreme pressure oils can only be brought out at high pressure and speed, leading to high temperature.

In the papers dealing with viscosity, that by Groff explains the use of a chart for the graphical solution of a number of viscosity-temperature problems. Geniesse describes the kinematic viscosity measuring equipment which has been adopted by the American Society for Testing Materials, and the new viscosity-temperature chart. Barr describes viscometer bath arrangements for high temperatures, and suggests a new empirical formula for expressing viscosity-temperature relationship. Suge gives an account of his methods and results of measurement of viscosity up to high temperature and pressure; he finds that the product of surface tension and coefficient of compressibility is a constant, and measures the thermal conductivity of oils. Bradford and Vandegriff quote Dow's results on the effect of pressure on the viscosity of mineral oils.

Coming now to papers dealing with oxidation tests of oils, Andrews finds that the rate of separation of water-in-oil emulsion is a good guide to the condition of a turbine oil in service. Moorbeek is critical of the

many oxidation tests for internal combustion engine oils on account of the disagreement between their results and the lack of correlation with engine behaviour; he is pessimistic as to their ultimate capability of predicting the behaviour of oils in engines. Mardles and Ramsbottom provide extensive results on the oxidation of oils with varying temperatures, time and method of oxidation. Hanson and Egerton, finding that gumming increases when engine knocking occurs and that nitrogen oxides are formed particularly under these conditions, have investigated the connexion between the two; they find that nitrogen oxides, even in small proportion, have a marked catalytic effect on oxidation, and suggest that this may be one of the factors leading to lack of correlation between laboratory and engine tests. Moutte, Dixmier and Lion find that they get improved correlation by first oxidizing the oil at low temperature and then subjecting it to high temperature. Evans and Kelman have found that soaps such as tin oleate can inhibit the catalytic effect of iron on oxidation, and by engine tests have chosen optimum proportions of tin and chromium oleates for an engine oil.

The time has certainly not yet arrived when the principles of lubrication can be said to be satisfactorily established on a scientific basis: clearly, much additional and carefully co-ordinated research of a really critical nature must be carried out. Nevertheless, progress has been made and certain underlying physico-chemical concepts are emerging. The papers contributed to this general discussion form an admirable review of the present position, and their detailed study is recommended to all interested in the theory and practice of lubrication and lubricants.

H. J. G.

Recent Advances in Horticulture

MANY useful reviews are contained within the pages of vol. 5 of the Horticultural Education Association's yearbook for 1937 "Scientific Horticulture" (Pp. 196 + xxxii, 3s. 6d. net, from the Hon. Editor, S. E. Agric. Coll., Wye, Kent), which constitute a welcome channel for the distribution of knowledge from the research worker to the teacher of horticulture. "Some Recent American Work on the Copper Fungicides" is described by Mr. R. W. Marsh; Prof. Stoughton contributes "A Review of the Problem of Bud Dormancy". Dr. O. N. Purvis discusses recent Dutch research on the temperature requirements of hyacinths, and Dr. Meirion Thomas has a paper on "Plant Hormones and Their Possible Importance in Horticulture". Dr. F. Kidd and Dr. G. West show that apples destined for long-period gas storage should be picked within a fortnight of the 'climacteric phase'. This is the time when growth in size of the apple ceases in autumn, and is indicated in practice when the fruit can just be detached by gently twisting it on its stalk. The late Dr. W. Maldwyn Davies describes the results of his experiments on factors which affect the distribution of virus-transmitting aphids, particularly *Myzus persicae*. Winged individuals of this species fly readily when the temperature reaches 65° F. Increasing humidity deters the movement of winged aphids, and flight ceases

completely when the wind velocity rises above four miles per hour. Dr. T. Whitehead has correlated this knowledge with a survey of districts in North Wales which are suitable for the growth of virus-free seed potatoes.

Messrs. B. S. Furneaux and W. G. Kent have investigated a malady of fruit trees known as the 'death'. This is due to the suffocation of roots by rise of the water-table after planting in a dry period, whilst wind-rocking of newly planted trees is often a contributory cause. Research work in progress at the John Innes Horticultural Institution is reviewed by Mr. W. J. C. Lawrence, and at the St. Ives Research Station by Mr. R. B. Dawson, who also contributes a paper on the routine management of lawns. Dr. W. G. Ogg discusses the reclamation of peat land and the utilization of peat as a mulch, as a potting medium, and as a source of organic matter for garden soils. Prof. G. W. Robinson discusses more general problems of horticultural soils.

Papers dealing with practical topics also appear in the volume.

CHESHUNT RESEARCH STATION

The twenty-second annual report, for 1936, of the Experimental and Research Station sponsored by the Nursery and Market Garden Industries' Development

Society, Limited, at Turner's Hill, Cheshunt, Herts, shows that much work is being directed towards the improvement in quality of tomatoes. The director, Dr. W. F. Bewley, and Mr. J. Harnett, have investigated the condition of tomatoes upon arrival at the wholesale markets in many parts of England, and much information has been made available for growers. Manurial and crop-management trials have been continued, and a method for restricting the root systems of tomato plants within clay pots gives earlier ripening and enhanced quality. Soil heating, applied after the two bottom trusses have set, gives a greater yield than the use of continuous ground warmth from planting time.

The Station now possesses a mushroom house, where an attempt is being made to understand the cultural requirements of this plant, and where the incidence of pests, and the appearance of undesired fungi, can be studied and controlled. A truffle fungus, *Pseudobalsamia microspora*, has been described as a new invader of mushroom beds. Several new fungal diseases of flowering plants have been described.

An interesting method of testing for the presence of spotted wilt virus in chrysanthemum plants has been evolved. This virus is scarcely tolerant of oxidation, and it is difficult to inoculate such hosts as tobacco or tomato with it. A dilute solution of sodium sulphite, acting as a reducing agent, allows such inoculations to be performed with ease. The occurrence of the eelworm *Anguillulina dipsaci* upon the tomato has been recorded, and the marking of tomato fruits with circular rings is shown to be the result of drops of water containing *Botrytis* spores.

LONG ASHTON RESEARCH STATION

The annual report of the Agricultural and Horticultural Research Station at Long Ashton, Bristol, for 1936, sets forth the results of a number of investigations which are especially practical in their outlook. A new section deals with soil surveys; Dr. T. Wallace has described the soils in the Vale of Evesham, in their relation to fruit and vegetable crops, and Dr. D. A. Osmond has studied the more intensive problem of the Station's pedology. Mr. G. T. Spinks reports work in progress on apple breeding, and variability of apple trees on seedling and on clone rootstocks.

Drs. T. Swarbrick and W. E. Berry have carried out yield trials with various black currant varieties in relation to the system of pruning adopted. They give the interesting result that hard pruning reduces the crop significantly in every case. The same two workers have also inquired into the incidence and spread of the virus disease of black currants known as 'reversion'. They indicate a correlation between the appearance of big bud, caused by a gall mite, and the virus, though big buds have never been observed before the symptoms of reversion, on the same bush. This raises the possibility that the gall mites may be present upon a bush for some time, in numbers sufficient to transmit reversion, but insufficient to produce a gall.

Dr. H. G. H. Kearns, Mr. R. W. Marsh, Dr. H. Martin, and Mr. E. Umpleby have a number of papers upon the control of pests and diseases by spraying. A third progress report on the use of combined washes is given, and sulphite lye has been used as an emulsifier. Dr. C. L. Walton shows that a type of parsnip canker is caused by the eelworm *Anguillulina dipsaci*, which can also induce similar

symptoms on onions, and in collaboration with Messrs. L. Ogilvie and C. J. Hickman, a study of the effect of nitrogenous fertilizers on potato 'sickness' has been made. The eelworm, *Heterodera Schachtii*, which causes the trouble, evidently interferes with the nitrogenous metabolism of the potato, and the yield of tubers on 'sick' land can be increased by the application of nitrogenous manures.

Mr. P. T. H. Pickford reviews the cider-making trials during the year, and Mr. Vernon L. S. Charley contributes two papers upon principles involved in the manufacture of fruit juice syrups. This work is of importance in providing a new and steady market for various fruits, and should help materially in the economic management of the extremely variable yield of home-produced fruit. A study of the dormant buds of the cricket-bat willow, as they affect the wood, has been made by Mr. H. P. Hutchinson, who also inquires into the effect of lateral branches upon the production of sets in this species of willow.

CULTURE OF AMARYLLIDS

The American Amaryllis Society has decided upon the title *Herbertia* for its third, and all subsequent year-books. This is to honour the pioneer work of William Herbert, whose published work on the Amaryllidaceae appeared in 1837. Vol. 3 (Pp. 151, from the editor, Dr. Hamilton P. Traub, Mira Flores, Orlando, Florida, U.S.A., 1936) is dedicated to Arthington Worsley, whose contributions to the culture of amaryllids are acknowledged in a short appreciation by Lord Aberconway, president of the Royal Horticultural Society of England. The botanist will find much of interest in the volume, particularly in the sections dealing with the physiology of reproduction and with genetics and breeding. Little is yet known about causes which influence the balance between flowering and vegetative propagation in bulbs. A paper on "The Propagation of *Zephyranthes rosea* by Under- and Over-Feeding" by Dr. Hamilton P. Traub and A. E. Hughes, provides a welcome introduction to the effect of soil nutrients upon propagation by bulbils. I. W. Heaton describes the propagation of amaryllids by destruction of the terminal bud, and Wyndham Hayward gives a method for propagating *Lycoris* by basal incisions. Dr. Traub has a further paper on "Growth Responses Following Stem Cuttage of Amaryllids".

The most widely interesting contributions in the section on genetics and breeding are, perhaps, those which relate to the storage of pollen. It has only been possible in the past to cross-pollinate such varieties as overlapped each other in their times of flowering. It is now possible to store pollen of many species for a considerable time. Miss Norma E. Pfeiffer has shown that the best conditions for storage are provided by a temperature of 10° C. with a relative humidity of 35-50 per cent. Dr. Traub shows how such a humidity can be preserved in an enclosed space by means of saturated solutions of various salts. Dr. A. B. Stout has an article on the evaluation of horticultural clones of day lilies, and there are also papers upon specific genetic problems relating to the Amaryllidaceae by S. P. Lancaster, G. W. Gibson, R. T. van Tress, and Wyndham Hayward.

The section on colour description includes three papers on colour photography, and the colour charts of Fischer and the Royal Horticultural Society are discussed.

Science News a Century Ago

Captain Back's Voyage in H.M.S. *Terror*

AT the opening meeting of the session of the Royal Geographical Society on November 13, 1837, many interested in Arctic exploration assembled to hear Captain (afterwards Admiral Sir) George Back (1796-1878) give an account of his voyage in the *Terror*, made at the instance of the Society with the object of furthering knowledge of the North-West. Leaving England in June 1836, he passed through the Hudson Strait and shortly afterwards in exceptional circumstances was beset in the ice off Southampton Island. Speaking of his experiences off the Island he said: "The frost-smoke that allured us vanished as we drew near, and the dark lanes of water from which it originated closed firmly, to the utter impossibility of proceeding one yard farther. Left, therefore, to the influence of events, we were borne backwards and forwards, according to the eccentric movements of the ice, crowding sail when the least crack showed a probability of an opening, or with the aid of saws, axes and ice anchors, working a few paces, until the most closely packed ice finally arrested our progress twelve miles from Cape Bylot, when only fifteen more would have ensured a safe wintering place in Duke of York's Bay."

The ship remained fixed in the ice from September 1836 until June 1837, when owing to the damage done to her it was necessary to return home. On the way home she leaked so much as to need incessant pumping, and to secure the ship, said Back, "we were obliged to strap her together with the stream chain cable. . . ." The *Terror* arrived back in Lough Swilly on September 3, 1837.

The Royal Society's New Barometer

ON November 16, 1837, Francis Baily read a communication to the Royal Society, entitled "Description of a new Barometer recently fixed up in the Apartments of the Royal Society; with remarks on the mode hitherto pursued at various periods, and an account of that which is now adopted, for correcting the observed height of the mercury in the Society's Barometers". In the course of his paper, Baily referred to the height of the Society's barometer above the mean level of the sea, about which there appears to have been some uncertainty. Thus prior to 1823 the cistern of the barometer is said to have been 81 ft. above the level of low-water spring tides at Somerset House, but without any information how this was connected with the sea. From 1823 until 1825 inclusive, it was said to have been 100 ft. above the same level, and from 1826 until 1836 inclusive the height is said to have been 83 ft. 2½ in. above a fixed mark on Waterloo Bridge or above the mean level of the sea (presumed about 95 ft.). The discordance between the 81 ft. and the 100 ft. was accounted for in as much as the old barometer prior to 1823 was fixed in the Council room while the Daniell barometer of 1822 was fixed in the closet adjoining the library on the floor above the Council room. With respect to the mark on Waterloo Bridge, the reference level was the surface of the granite pedestal at the base of the columns at the north abutment of the bridge and on the eastern side, a reference point "more durable, and more convenient than any mark that could have been inscribed by hands".

Taylor's Scientific Memoirs

ON November 18, 1837, the *Mechanics Magazine* under the above heading said: "The first volume of this collection of translations from the foreign scientific periodicals is now completed, and we are sorry to find the editor and proprietor has still to complain of a want of adequate patronage. He has suspended the continuation of the work for the present, to give an opportunity for men of science to come forward in its support, before he commits himself by commencing the second volume. As the great utility of such a publication is too manifest to admit a doubt . . . it is to be hoped that Mr. Taylor's appeal will not be in vain. Richard Taylor (1781-1858) was a printer and naturalist and a member of various scientific societies. He was the publisher of the *Annals of Philosophy* founded in 1813, which was incorporated in 1827 with Tilloch's *Philosophical Magazine* founded in 1797.

Cholera in Africa

THE *Lancet* of November 18, 1837, contains the following information: "The cholera has just broken out in the *Dey's Hospital* at Algiers. On the 14th of October seventeen cases and nine deaths were reported. At Bona, where the epidemic has been prevailing for some time, the number of cases on the 17th of October had amounted to 318, the deaths to 180. One of the most curious points in the history of the Asiatic Cholera is, perhaps, the steady proportion of deaths to cases which may be observed to have occurred in all parts of the world and in all climates. This fact proves how very little as yet has been done in the treatment of the disease!"

University Events

CAMBRIDGE.—The Vice-Chancellor has announced that the University has received from Mr. J. W. O. Hamilton, of Chesterfield House, 98 Great Tower Street, London, E.C.3, an album entitled "The Commercial Development of Radio-telegraphy, Telephony and Broadcasting", and a cheque for £500 to found a prize for the encouragement of radio research in the University. Mr. Hamilton wishes the prize to be associated with the names of James Clerk Maxwell and Sir Ambrose Fleming.

It is proposed that Prof. F. Debenham and J. A. Steers, of St. Catharine's College, be appointed to represent the University at the International Congress of Geography in Amsterdam on July 18-28, 1938.

LONDON.—The degree of Doctor of Literature *honoris causa* was conferred on H.M. the Queen in the presence of H.M. the King on November 10.

The following doctorates have recently been conferred: D.Sc. in chemistry on Mr. A. N. Dey (Imperial College—Royal College of Science); D.Sc. in statistics on Mr. M. S. Bartlett.

OXFORD.—The honorary degree of D.Litt. will be conferred on November 20 on Dr. R. R. Marett, rector of Exeter College since 1928 and reader in social anthropology since 1910.

K. A. H. Murray, of the Agricultural Economics Research Institute, has been elected fellow and bursar of Lincoln College.

Societies and Academies

Edinburgh

Royal Society, October 25.

J. W. S. MARR: Antarctic surveys: The work of the "Discovery" investigations (Bruce Memorial Prize lecture, 1936). The Discovery Committee, in spite of the heavy commitments of a comprehensive oceanographical programme, has not overlooked the urgent need for reliable charts of the little-known Antarctic lands, and of the widely scattered, remote and frequently inaccessible island groups that are the dependencies of the Falkland Islands. Among other things it was this aspect of the Committee's researches that Dr. W. S. Bruce himself had so strongly supported in an interview at the Colonial Office nearly twenty years ago. In the twelve years the Discovery investigations have been in existence, much has been done to further existing knowledge of these distant coasts. The cartography of this region is emerging slowly from a state of uncertainty and confusion, and will, it is hoped, in time reach one which may prove useful to future scientific or commercial enterprise.

Paris

Academy of Sciences, September 27 (*C.R.*, 205, 529-548).

CHARLES JACOB: Obituary notice of Albert Heim.
LOUIS LAPIQUE: Isochronism as a condition of intercellular transmission of stimulation.

PAUL LÉVY: New contribution to the arithmetic of products of Poisson's law.

RODOLPHE HENRI GERMAY: The existence of functions associated with the solutions of completely integrable systems of total differential equations with linear coefficients.

SANTIAGO ANTUNEZ DE MAYOLO: The composition of the electron and the energy of fixation.

PIERRE DUPIN and LOUIS SACRÉ: The measurement at a distance of the electrical state of the surface of insulating bodies.

Mlle. SUZANNE VEIL: The presence of iodine dissolved in aqueous solutions of potassium iodide, and the electrical properties of the medium.

HENRI MOUREU, MICHEL MAGAT and GEORGES WETROFF: The stereochemical structure of phosphorus pentachloride. In an earlier paper, the authors have suggested that phosphorus pentachloride exists in two forms, the solid state possessing an unsymmetrical structure, the liquid form a symmetrical structure. These considerations are applied to explain anomalies of electrical conductivity and dielectric constant described by various authors, and also certain differences in chemical reactivity.

Amsterdam

Royal Academy (*Proc.*, 40, No. 7, Sept. 1937).

J. CLAY: The energy and penetrating power of cosmic rays. A survey of the evidence for the energy and corpuscular nature of cosmic rays.

F. M. JÄGER, J. TER BERG and P. TERPSTRA: Optical rotation and rotatory dispersion in solution and in the crystalline state.

P. E. VERLADE, J. VAN DER LEE, Miss J. C. DE QUANT and E. DE ROY VAN ZUYDEWIJN: New methods for the synthesis of glycerides (2).

Miss W. A. LUB: The optical spectrum of actinium. New lines due to actinium.

Miss J. G. EYMERS and H. P. BOTTELIER: Proto-plasmic movement in the oat coleoptile as related to oxygen pressure and age.

A. KAWAGUCHI: The relation between a metric, linear connexion and a non-metric one in a general metric space.

P. TERPSTRA and J. TER BERG: The crystal form of some complex salts of triaminopropane with trivalent cobalt and rhodium.

A. W. H. VAN HERK: The chemical processes in the spadix of *Sauromatum*.

G. C. HIRSCH: Outlines of a theory of the Golgi bodies. (1) The Golgi bodies in space.

L. H. BRETSCHNEIDER and J. J. DUYVENÉ DE WIT: The hormone chain: active urine substance → ovary → ovipositor in *Rhodeus amarus*.

P. JULIEN: (1) Distribution of the blood groups in some peoples of Liberia and Sierra Leone. (2) Studies in blood group correlations in some peoples of Liberia and Sierra Leone.

Cracow

Polish Academy of Science and Letters, July 1.

W. JACZYNA: The thermodynamic scale below 1° K. Data concerning the thermodynamic scale below 1° K. are doubtful for two reasons, the inexactitude of the thermomagnetic equation and the irreversibility of the adiabatic demagnetization.

T. BANACHIEWICZ: The numerical solution of a system of linear equations.

B. KAMIENSKI: Thermodynamical considerations on dielectric potential and surface tension.

B. NIKLEWSKI and Mlle. J. WOLNICKA: The morphological phenomena produced as the result of chemotropic irritation of the roots.

H. GROSSFELD: Osmotic pressure and intravital coloration.

H. GROSSFELD: A method applied in researches on the permeability of animal tissue cells.

Rome

National Academy of the Lincei (*Atti*, 25, 353-412; 1937).

A. DE MIRA FERNANDES: Expressions for the curvature of a surface.

G. PALAMÁ: The transformation of Gauss and the Hermite polynomials.

T. TURRI: An observation on the classification of curves of the second kind.

G. COLONNETTI: The elastic equilibrium of systems in which non-elastic deformations also occur (1).

G. PERETTI: Plastic sources.

C. TOLOTTI: Generalization of Dirac's equations for the space of general relativity.

L. CAVALLARO: Absorption bands in polar substances at very high radio frequencies (1).

A. MANGINI: Aromatic nitroderivatives (13). Some substituted α -naphthylamines.

G. DAL PIAZ: Geological structure of the Austrides (5). Some further work on the Austrian alpine system of the Eastern Alps.

A. CAVINATO: Morenosite from Val Malenco.

G. BORZINI: Observations on the parasitism of *Sclerotinia libertiana sclerotiorum* Fuck associated with other fungi.

A. SALVATORI: Further contribution to the study of post-operation hypochloræmia.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 15

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—H. St. J. B. Philby: "The Land of Sheba" (Asia Lecture).

Tuesday, November 16

CHADWICK PUBLIC LECTURE (at Manson House, 26 Portland Place, W.1), at 5.15.—Dr. Bernard Myers: "The Promotion of Health in the Empire Citizen".*

GRESHAM COLLEGE, BASINGHALL STREET, E.C.2, at 6.—A. R. Hinks, F.R.S.: "Nebulae as External Galaxies" (succeeding lectures on November 17, 18 and 19).*

Wednesday, November 17

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—J. E. Barnard, F.R.S., and F. V. Welch: "The Principles of Fluorescence Microscopy".

Thursday, November 18

LONDON MATHEMATICAL SOCIETY, at 5 (at the Royal Astronomical Society, Burlington House, W.1).—Annual General Meeting.

Prof. G. B. Jeffery, F.R.S.: "Mathematical Studies in the Modern Universities".

CHEMICAL SOCIETY, at 8.—Dr. J. M. Robertson: "Bond Character and Interatomic Distance".

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS—(at Manson House, 26 Portland Place, W.1), at 8.—Annual General Meeting.

Dr. Marie Stopes: "The Year's Work, and Behind the Scenes in the Present Crisis".

Friday, November 19

ROYAL INSTITUTION, at 9.—Sir William Bragg, O.M., F.R.S.: "Clay".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN ELECTRICAL ENGINEERING in the Wolverhampton and Staffordshire Technical College—The Director of Education, North Street, Wolverhampton (November 13).

LECTURER IN ENGINEERING in South-East Essex Technical College, Dagenham—The Clerk to the Governors (November 15).

ASSISTANT ENGINEER in the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Metropolitan Buildings, Northumberland Avenue, W.C.2 (November 17).

SCIENTIFIC OFFICER in the Air Ministry Scientific Research Pool—The Secretary, Air Ministry (S.2.d. Room 405), Admiralty House, Kingsway, W.C.2 (November 20).

TECHNICAL OFFICER in the Directorate of Armament Development of the Air Ministry—The Secretary, Air Ministry (S.2.d. Room 406), Admiralty House, Kingsway, W.C.2 (November 20).

JUNIOR SCIENTIFIC OFFICERS in the Electricity, Radio and Aerodynamics Departments of the National Physical Laboratory, Teddington, Middlesex—The Director (November 22).

PHYSICIST at the Liverpool Radium Institute, 1 Myrtle Street, Liverpool—The Secretary (November 30).

PROFESSOR OF PHYSICS in University College, Aberystwyth—The Principal (November 30).

PROFESSOR OF CHEMISTRY in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (December 15).

DEWAR RESEARCH FELLOW IN CRYSTALLOGRAPHY in the University of Edinburgh—The Secretary (December 15).

GENETICIST to the Rubber Research Scheme (Ceylon)—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, S.W.7 (December 31).

JUTE SPECIALIST to the Indian Central Jute Committee—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (December 31).

STRUCTURAL ENGINEERING ASSISTANTS in the Directorate of Fortifications and Works of the War Office—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (Quote Apts./56).

SENIOR AND JUNIOR RESEARCH ASSISTANTS in the Courtauld Institute of Biochemistry, Middlesex Hospital, W.1—(The Secretary).

SENIOR LECTURER IN GENERAL AND INORGANIC CHEMISTRY in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1.

SENIOR LECTURER IN ANATOMY in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1.

Official Publications Received

Great Britain and Ireland

Forestry Commission. Leaflet No. 22: Pruning in Young Plantations. Pp. 12. (London: Forestry Commission.) [2610]

Technical Publications of the International Tin Research and Development Council. Series A, No. 63: The Corrosion of Tin in nearly Neutral Solutions. By Dr. T. P. Hoar. Pp. 16. Free. Series A, No. 64: Surface Tension and Viscosity Phenomena in Tinplate Manufacture. By Dr. Bruce Chalmers. Pp. 10. Free. (London: International Tin Research and Development Council.) [2810]

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1936. Pp. 294. (Harpenden: Rothamsted Experimental Station.) 2s. 6d. [2810]

Institution of Gas Engineers. Publication No. 162: The Low-Temperature Carbonization of Scottish Cannel. By Dr. J. G. King and James Jamieson. Pp. 16. Publication No. 165: Third Report of the Research Executive Committee, 1936-37. Pp. 24. Publication No. 167: Forty-first Report of the Joint Research Committee of the Institution and Leeds University—The Investigation of the Use of Oxygen and High Pressure in Gasification, Part 2: Synthesis of Gaseous Hydrocarbons at High Pressure. Pp. 48. (London: Institution of Gas Engineers.) [2810]

Hull Museum Publications. No. 191: The *Sirius*, the first Steamer to Cross the Atlantic. By Thomas Sheppard. Pp. 15. No. 193: A Roman and Saxon Site at Elmswell, East Yorks., 1935-1936. By Anthony L. Congreve. Pp. 28. No. 194: Excavations at the Roman Town at Brough, E. Yorkshire, 1936. By Philip Corder and the Rev. Thomas Romans. Pp. 69+3 plates. (Hull: Hull Museum.) [2910]

Decennial Index of *The Analyst*, the Journal of the Society of Public Analysts and other Analytical Chemists. Vols. 51-60 (1926-1935). Compiled by M. B. Elliott. Pp. 467. (Cambridge: W. Heffer and Sons, Ltd.) 25s. net. [2910]

ULAWS Monographs and Reports, No. 4E: Instructions for dealing with Rabbits. Compiled by Capt. C. W. Hume. Second edition (revised). Pp. 16. (London: University of London Animal Welfare Society.) [3010]

Other Countries

Instituto Nacional de Tecnologia. Copias do Brasil: Resinas de Jatoba, Tapoca e Jutahyca. Pelos José Lula Rangel e Haya S. Schneider. Pp. 42+2 plates. Nota sobre os Fosfatos de Trauhira (Bauxita e laterita fosforosa.) Por S. Fróes Abreu. Pp. 38+4 plates. Rochas oleigenas do Brasil e seu aproveitamento. Pelo S. Fróes Abreu. Pp. 162+10 plates. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [2510]

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 22, Memoir No. 5: Cambrian Trilobites from Iran (Persia). By W. B. R. King. Pp. iv+22+2 plates. (Calcutta: Geological Survey of India.) 1.14 rupees; 3s. 3d. [2510]

Zweihundsechzigster Jahresbericht über die Tätigkeit der Deutschen Seewarte, 1936. Pp. 40. (Hamburg: Deutsche Seewarte.) [2510]

Forestry Pamphlet No. 5: Forestry and the Oil Industry. Pp. 4. (Port-of-Spain: Government Printing Office.) 12 cents. [2510]

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 155: Some Effects of Ignition Timing and Rate of Burning on the Thermodynamical Performances of High-Speed Compression-Ignition Engines. By Seichi Awano. Pp. 20. (Tôkyô: Kôgyô Tôsho Kabushiki Kaisha.) 55 sen. [2510]

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1936. Pp. 24. (Zomba: Government Printer.) 2s. 6d. [2610]

N.Z. Department of Scientific and Industrial Research. Apia Observatory, Apia, Western Samoa: Annual Report for 1934. Pp. 121. (Wellington: Government Printer.) 6s. [2710]

Oisir. Vol. 4: Incunabula Scientifica et Medica. By Arnold C. Kiebs. Pp. 359. (Bruges: St. Catherine Press, Ltd.) [2710]

Smithsonian Institution: Bureau of American Ethnology. Bulletin 116: Ancient Caves of the Great Salt Lake Region. By Julian H. Steward. Pp. xiv+131+9 plates. (Washington, D.C.: Government Printing Office.) [2710]

Maryland Geological Survey. Vol. 13. Pp. 295+46 plates. (Baltimore, Md.: Johns Hopkins Press.) [2710]

Smithsonian Institution: United States National Museum. Bulletin 169: The Fort Union of the Crazy Mountain Field, Montana, and its Mammalian Faunas. By George Gaylord Simpson. Pp. x+287+10 plates. (Washington, D.C.: Government Printing Office.) 45 cents. [2810]

Tanganyika Territory: Department of Agriculture. Annual Report, 1936. Pp. 100. 4s. Pamphlet No. 16: The Sisal Experimental Station; Report for the Year 1936. Pp. 12. 6d. Pamphlet No. 17: Reports from the General Experimental Farms, 1936. Pp. 40. 6d. (Dar es Salaam: Government Printer.) [2810]

National Research Council of Canada. Bulletin No. 18: Chemical Weed Killers; a Review. By W. H. Cook and A. C. Halferdahl. Pp. 111. (Ottawa: National Research Council of Canada.) 25 cents. [3010]

Catalogues, etc.

Apparatus for the Measurement of Dielectric Constants (Dipole Measurements). (Dipol 36.) Pp. 6. (Delft: F. J. Kipp and Zonen; London: W. Edwards and Co.)

Voyages and Travels, Americana, Important Historical Works, Early Scientific Books, etc. (Catalogue No. 617.) Pp. 72. (London: Francis Edwards, Ltd.)

Vermes. (Catalogue No. 93.) Pp. 68. (Den Haag: Antiquarist W. Junk.)

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3551

SATURDAY, NOVEMBER 20, 1937

Vol. 140

Social Aspects of Nutritional Science

THOUGH there is still a tendency among certain people to deplore the passing of the "good old days", it has to be acknowledged that during the past century and a half the lot of the poorer sections of the populations of western Europe has been enormously improved. In the past, war, famine and pestilence have decimated many countries; to-day, in Europe, famine is the exception and many types of pestilence have been already almost forgotten, although the widespread occurrence of infectious diseases, especially influenza in pandemic form, yet offers many problems for preventive medicine. The advance in public health and well-being, strikingly shown by the fall in the death-rate and the extension in the expectation of life of the individual, was made possible by the advances in sanitation and medical knowledge, and the improvement in the social conditions of the lower-income groups was due to the rapid growth of wealth, which resulted mainly from the advances in scientific knowledge and its application. The awakening of the social conscience of the community has frequently played no mean part in these advances.

In spite, however, of the improvement in the health of the people, it is only comparatively recently that it has been realized what an important part nutrition plays in maintaining health: with increasing wealth, diet has become more abundant and more varied, but the improvements in the past have been largely the result of the unconscious and instinctive groping of men for a better and more abundant life. To-day, medical science can state, within limits, what is a good and what is a bad diet: therefore, it is possible from dietary studies to determine whether people are eating the right kinds of food in sufficient quantities.

Further, our knowledge of the results of consuming ill-balanced diets has increased to the extent of enabling us to say, in many cases, from a clinical examination, whether malnutrition is present and what particular element in the diet is lacking, even apart from the obvious occurrence of what are now known as the frank 'deficiency diseases', such as scurvy, rickets or beriberi.

Perusal of the recent report of the League of Nations on nutrition, reviewed elsewhere in this issue, shows, however, that in spite of the general improvement in the social conditions of the poorer sections of the communities of western Europe in recent decades, much malnutrition still exists, even in the richer countries. The evidence is both clinical and economic: dietary and income surveys have shown that among the lowest-income groups it is simply impossible for the members to obtain a proper diet, since the family income is insufficient! Nutrition policy, therefore, must be directed both to educating people in the elements of correct dietetics, and also, which is even more important, to enabling *everyone* to make full use of our present knowledge, by bringing the foodstuffs essential to health and physical development within reach of all sections of the community. No campaign for improving physical fitness can succeed when nutrition is at fault.

What, then, does improved nutrition imply? Usually an increased consumption of animal protein, milk, eggs, 'fat' fish, green vegetables and fresh fruits, with a decreased consumption of cereals: in other words, a decrease in the consumption of the purely energy-bearing foods, and an increase in that of the so-called "protective" foods, which are in general the more expensive. Dietary surveys have shown that with increasing

income, more of the protective foods are consumed ; the problem is therefore largely economic—how to increase the incomes of the more poorly paid sections of the community, or, alternatively, how to reduce the price of the protective foods, which comes to the same thing. One objection, that the shift in consumption will cause distress among many agriculturists, is shown in the League of Nations report to be of no weight. For many years agriculture has been adapting itself to just such a shift in consumption, which has occurred with the general increase in wealth of many countries ; moreover, cereals formerly produced for human consumption can also be used as animal feed when the demand for meat and milk increases.

It is impossible to-day for Governments to divest themselves of responsibility for the nutrition of their peoples ; nutrition should be considered to-day the most important of all the social services.

Education in the correct principles of nutrition and avoidance of policies which may prevent the full use of adequate diets should be the foremost considerations of legislators as steps in the improvement of the well-being and health of their peoples. It must be emphasized that the problems are indeed complex ; thus a simple reduction in the price of food may benefit the urban consumer but bring ruin and malnutrition to the agricultural producer.

The League's report on nutrition should be in the hands of all who have the welfare of the people at heart, especially those entrusted with the direction of policy. If Governments can achieve for their peoples adequate levels of food consumption, further progress, in no way less spectacular than that achieved during the nineteenth century, can be made in increasing the quantity and raising the quality of human life.

Logic and Empiricism

Actes du Congrès International de Philosophie scientifique, Sorbonne, Paris, 1935

1 : Philosophie scientifique et empirisme logique. Pp. 81. 12 francs. 2 : Unité de la science. Pp. 77. 12 francs. 3 : Langage et pseudo-problèmes. Pp. 60. 10 francs. 4 : Induction et probabilité. Pp. 65. 10 francs. 5 : Logique et expérience. Pp. 80. 12 francs. 6 : Philosophie des mathématiques. Pp. 85. 12 francs. 7 : Logique. Pp. 73. 10 francs. 8 : Histoire de la logique et de la philosophie scientifique. Pp. 92. 12 francs. (Actualités scientifiques et industrielles, 388-395.) (Paris : Hermann et Cie., 1936.)

SCIENTIFIC philosophy may be in a state of flux in its details, but there is one guiding principle which seems to give at least a unity of purpose to the numerous schools of thought which have made logic their chief interest. This principle requires that the reconstruction of our knowledge should be made on the basis of experience alone, free from anthropomorphic additions, and by means of a unified scientific language shaped out of logical syntax. Let it be said at once that few thinkers would dispute the fundamental importance of this principle, provided that it is interpreted in a liberal spirit. It seems, however, that the more vocal logicians of to-day deliberately restrict experience to sense-data alone,

thus leaving out those no less important aspects of experience which refer to moral, æsthetic, mystical and religious values. Without arguing the point as to whether it is possible or not to achieve a complete synthesis of our knowledge with these initial restrictions on the meaning and acception of experience, it can be admitted that this narrow interpretation of the guiding principle of scientific philosophy has aroused the enthusiasm of all those important thinkers who have adopted Russell's motto that logic is the great liberator of the mind. The Paris Congress of Scientific Philosophy is the first result of their intellectual crusade, though some of its meetings were tempered by the presence of more traditional thinkers.

Unity of purpose, however, is not incompatible with difference of interests ; and it is not one of the least remarkable aspects of the vitality of logic that it has developed in so many directions. The variety of the papers under review bear witness to this statement. Thus, the first fascicule, devoted to "Philosophie scientifique et empirisme logique", contains a series of declarations of faith in logical empiricism by some leaders of the movement such as Russell, Frank, Reichenbach, Carnap, Neurath, Enriques, Morris, Wiesner, Chwistek, Kotarbinski, Ajdukiewicz and Prof. Louis Rougier, who organized the Congress so ably and supervised the publication of the papers.

Most of them are inclined to think that speculative metaphysics does not even deserve the honour of a discussion, and they busy themselves with the organization of a "scientific empiricism which by doing justice to the three dimensions of meaning is able to unite the attitudes of formalism, pragmatism and traditional empiricism, and at the same time to give the promise of resolving the inadequacies which have beset previous forms of empiricism" (C. W. Morris, 1, 56). The elimination of idealism from mathematics as well as from other sciences is suggested by the use of the super-general science of 'semantics' (Chwistek, 1, 79).

The conditions of unifying the sciences and of illustrating their unity by means of an International Encyclopædia, are discussed in the second fascicule, "Unité de la science", in which, besides the able papers of representatives of the Vienna Circle, there is an important contribution by Lecomte du Noüy on the unity of the method of the physical and biological sciences, and an excellent discussion of the notion of 'type' by C. G. Hempel and P. Oppenheim. With regard to the International Encyclopædia, as originally conceived by O. Neurath, its purpose will be to show the 'structure' rather than the totality of our knowledge; and because of its purpose, it will have to make use of 'graphical representation' as an essential element of unification of our knowledge. The main conception and general plan of this International Encyclopedia have been approved by the Congress, which passed a resolution expressing its willingness to co-operate in the execution of the scheme, and appointed a special committee to discuss ways and means of unifying logical symbols. Semantics and linguistics are the subjects of the third fascicule, "Langage et pseudo-problèmes", which contains papers by Tarski, Padoa, Chevalley, Rougier, Vouillemin, Matisse, Feigl and others. The accusation levelled by Rougier against Aristotelian logic, that it helps to create pseudo-problems rather than solve them, is more dogmatic than convincing. A direct reply to this charge is given in a paper by the present writer on the significance of logical symbols.

Two essential problems of logical theory are discussed in the fourth fascicule, "Induction et probabilité", by Reichenbach, Carnap, Schlick, Zawirski, Hosiasson and Finetti. The arguments, however, are rather one-sided, as they refer to Reichenbach's well-known doctrine of probability, and to the assimilation of probability with a plurivalent logic proposed by the Polish school. Though the debate of this dual problem would have gained if it were less restricted, the papers in this fascicule clarify many aspects of the esoteric teachings of logical empiricism.

The fifth fascicule, "Logique et expérience",

contains papers on definition and experience by Ajdukiewicz, Benjamin and Renaud, on the formalization of experience by Petiau, Destouches, Métadier, Habermann and Chwistek, and on protocol-judgments by Braithwaite, Rasmussen and Grelling. Most of the arguments refer to physical experiments rather than to physical experience under the influence of different types of causes and conditions. Owing to the paramount importance of experience in logical empiricism, it was legitimate to expect a fuller treatment of sense-data and of their integration in a unified system of knowledge.

The sixth and seventh fascicules deal respectively with "Philosophie des mathématiques" and with "Logique". This seems to point to a real division between mathematics and logic, a conception heretical to the Russellian tradition, but none the less true and widely accepted. It inspires most of the papers on mathematics and reality (Gonseth and Lautman), on the theory of groups (Juvet, Bouligand, Destouches), or the intuitionist logic (Mania, Jaskowski, Raymond, Becker and Schrecker), on logical syntax (Tarski, Helmer, Sperantia and Lindenbaum) and on mathematical logic (Bachman, Padoa, Bergmann and others). These papers carry further the process of clarification of mathematical logic which was initiated when flaws were discovered in the awe-inspiring and monumental "Principia Mathematica".

The historical aspect of the problems raised by logical empiricism is the subject of the eighth and last fascicule, "Histoire de la logique et de la philosophie scientifique". One will not find in it any elaborate considerations about the historical development of logic as a whole. With the exception of an essay by Jasinowski on the limitations of Greek mathematics, all the other papers (Scholz, Raymond, Bachmann, Padoa, Tegen, Ayer, Hollitscher, Zervos, Jørgensen, Frank and Heinemann) refer to the development of logical empiricism in the various countries of Europe, and to some particular aspects of the development of mathematical logic. As such they are very valuable. Ayer's paper on the analytic movement in British philosophy is particularly interesting, inasmuch as it explains some fundamental differences between this movement and the Continental developments of logical empiricism.

The importance of some of the technical results obtained by those who favour logical empiricism explains why this school of thought continues to attract much interest and controversy; and though logical empiricism has now lost the aggressiveness it showed at its earlier stages, it has still great vitality and real influence, which cannot be neglected in assessing the philosophical climate of our generation.

T. GREENWOOD.

A Survey of Organic Chemistry

Lehrbuch der Chemie

Von Prof. Walter Hückel. Teil 2: Organische Chemie. Pp. xvi + 602. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 18 gold marks.

THE author of a compact text-book of organic chemistry lays himself open to criticism because his selection of subject-matter can never meet with complete approval of other teachers and writers on the subject. Stressing fundamental principles and including only such descriptions of compounds as he deems necessary for the purpose of illustration, his work will probably be judged as lacking in subject-matter, a fact of which the author is fully conscious, realizing that, in its forty volumes, the present edition of Beilstein's "Handbuch" is still incomplete and when finished will only deal with the subject-matter of organic chemistry up to 1919. The literature of organic chemistry must be much greater than that of any other experimental science, and this literature takes little or no account of the vast amount of information obtained through detailed investigations by large industrial organizations. The rapid growth of this literature makes the writing of new text-books of organic chemistry increasingly difficult, and the justification of their publication should lie in the up-to-date treatment of classical organic chemistry and the careful choice of subject-matter to illustrate the general principles.

Prof. Hückel is not only an investigator but is also the author of the well-written "Theoretical Outlines of Organic Chemistry", of which the second edition appeared in 1934. To many British readers the present work will seem more old-fashioned than they would expect from him. On the other hand, the order of the subject-matter is different from that in many text-books, and few authors would discuss the alkaloids before the systematic treatment of stereochemistry and aromatic compounds.

Prof. Hückel has restricted the subject-matter of systematic organic chemistry to meet the first requirements of the general student and the large class of those who are required to possess a knowledge of organic chemistry as a medical science. He has omitted, for example, a number of the so-called classical syntheses, including those of quinoline, isoquinoline and indole. From a biological point of view, it can be maintained that these are key substances the study of which the author might have included in a book to be used

by biology students even if other subjects had to be dealt with in less detail. Even urea, the synthesis of which marks the beginning of systematic organic chemistry and which might well form the starting-point of a modern course of lectures in the subject, has to be given a far too condensed treatment so as to provide space for much more 'spectacular' and highly complicated subjects.

The survey of organic chemistry given by Prof. Hückel is much more comprehensive than that usually given in a text-book of this type. There would appear to be justification for the inclusion of the good but necessarily brief accounts of the carotenes, vitamins and the hormones, including the sex hormones; but it may be doubted whether the student has gained sufficient knowledge from the previous hurried treatment of the simple and fundamental compounds to appreciate fully the complexities of this advanced work. The additional disadvantage lies in the fact that perhaps many readers will not realize that this is far from being a finished chapter in organic chemistry. Undoubtedly, the average student will find this book inspiring because the subject-matter is dealt with so broadly, although he may not realize at this stage that there are defects in the treatment of what he may have come to regard as the dry bones of the subject.

One unusual and interesting feature in this kind of book is the inclusion of short biographical notices in appropriately placed footnotes. It is perhaps natural that the great majority of these are of German chemists, and of British modern investigators Prof. Robert Robinson is the only one so distinguished. Without detracting from the work of organic chemists in other countries, it is rather remarkable that in this modern text-book there is no mention of the classical work of Sir William Pope or of Sir Arthur Harden in connexion with the development of our knowledge of stereochemistry and fermentation respectively. Omissions are not confined to the work of non-German investigators. The account of the reactions of aromatic diazo compounds is very brief, and there is no mention of the well-known (Bart) reaction which now constitutes the method for the preparation of aromatic arsenical compounds of various types of the highest importance as chemotherapeutical agents.

There are a few typographical errors, and the wrong formula for thyroxine may be one of these. It is much more serious as indicating a certain

lack of care in the compilation of the book that the crystal drawings of the enantiomorphous sodium ammonium tartrates reproduced by the author and evidently copied from older text-books have little relation to the crystalline forms of these

substances and may be described as representing crystal monstrosities. It is unfortunate that the author of a new text-book should be so uncritical as to reproduce what has long been known to be an error in older books. CHARLES S. GIBSON.

Religion and Medicine of a West African People

Religion and Medicine of Gã People

By M. J. Field. Pp. xi + 214 + 16 plates. (London: Oxford University Press, 1937.) 17s. 6d. net.

THERE is a charming feminine inconsistency between Miss Field's announcement that she refrained from studying anything that anyone else had ever written concerning the subject upon which her own researches were to be directed—her only lapse in this respect being the "perfunctory" perusal "eight years ago" of a work dealing with a neighbouring tribe—and her acknowledgement of advice and criticism from various experts in her particular subject.

The author may, however, have had in mind the example of certain anthropological students, who, having sat with reverence at the feet of some great master, the originator of a new school of thought, are so influenced by his teaching that they, perhaps unconsciously, find further proofs to back up—or to bolster up—those pet predilections of a beloved teacher. Modern youth, however, of both sexes, is now inclined to display independence, and the functionists, diffusionists and what-nots, need not be surprised to discover rebels in the ranks of former pupils. It is well that it should be so. There is no science where an open mind and freedom from preconceived ideas are more essential than in a study of mankind's primitive institutions.

The title of this eminently sympathetic and thorough piece of field work perhaps disarms one otherwise obvious criticism.

It deals—and only purports to deal—with "religion and medicine"; in anthropological parlance, the latter term is often synonymous with the former. Yet there will be many, besides the writer of this notice, who would have wished to know more of the origin of this interesting West African people. Their curious affinity in customs, in language, and most of all in their folk-lore, with their northern neighbours, the Twi-speaking tribes, is very marked. Miss Field states, for example, that the religious songs at a certain ceremony were in the forgotten "Obutu dialect", and adds that these were often "mere gibberish to both singers and hearers". In a footnote, however, she states that her informants insisted that this "gibberish"

was Twi, but she adds that could not be so, for it would mean that the particular custom was a late, not an early, cult. "Fleeting glimmers" such as this—to use Miss Field's own expression—make us all the more anxious to probe still further into the question how far the Gã have been influenced by their northern neighbours.

The book plunges straight away into an account of Gã gods and their servants. In the first paragraph is the arresting statement that the whole idea of the *fetish* is foreign to Gã worship. "The typical Gã high-priests," the author writes, "have no fetishes and are not fetish priests". There is, of course, now, every reason to believe that among the Twi and Ashanti, the indigenous cults were equally free from the influence of the *suman*. These Gã people of the lagoons and Atlantic free-board appear, in spite of centuries of contact with Europeans, to have retained, unchanged, certain primitive institutions which have been lost or become obscured among the inland tribes. This has perhaps been due to the greater wealth and rise of native kingdoms and warlike confederacies among the latter, which postulate external influences, in their case, from the north, that is, from the great inland kingdoms of Ghana and Melle.

Miss Field also refers to the survival of priest-kings, still faintly discernible in the Ashanti *Asase-wura* (master of the earth) and functioning more clearly in the Ashanti hinterland in the person of the *Tendana*. "Gã governments," she writes, "were originally absolute theocracies, and the only rulers were the priests". Scores of similar analogies rise before the reader who is familiar with the Twi-speaking and other Gold Coast peoples. It is to be hoped that the author will one day bring her scholarship to bear on the problems thus suggested.

This book is a model of what sympathy and painstaking research can achieve. It is, indeed, on books of the kind that the whole science of anthropology is being reconstructed. Those scientific investigators who cannot themselves embark on field work can wholly rely upon, and safely draw correct deductions from, such a work.

R. S. RATTRAY.

An Irish Pilgrimage

The Way that I Went:

an Irishman in Ireland. By Robert Lloyd Praeger. Pp. xiv + 394 + 39 plates. (Dublin: Hodges, Figgis and Co., Ltd.; London: Methuen and Co., Ltd., 1937.) 21s. net.

THE way that the author went was all over Ireland, often to little-known areas, especially when obtaining data for "Irish Topographical Botany", a book for the achievement of which students of distribution will remain permanently indebted to him. Of the present work, Dr. Praeger writes, "this is not a guide book—Heaven forbid." Yet it partakes in no small degree of both the virtues and defects of that type of literature. As in the conventional guide book, the only connecting theme is that of location, and this produces a certain inconsequence which renders the book easy to dip into at any point but less suited for continuous reading. Unlike the conventional guide book, the text is more concerned with the works of Nature than the works of man, and the reader who loves the countryside can here share the author's simple pleasures. The work is, in fact, a *pot pourri*, albeit an unusual and charming one, of facts and reminiscences concerning, *inter alia*, the topography, geology and natural history of Ireland.

Whether the author is writing of how the pied wagtails have learnt to appreciate the night-life of Dublin, of the sole Irish stations for the rock rose on the Carboniferous Limestone at Ballintra and

the cloudberry on the bogs of the Sperrin, of cliff scenery or the story of the rocks, all are presented with a personal touch that gains materially from the many parts that the author has himself played in the investigation of Ireland's wealth of natural interest.

Dr. Praeger pays a well-merited tribute to the value of natural history societies in general, and particularly to his personal debt to the Belfast Naturalists Field Club, which he joined at eleven years of age. His emphasis on the value of intensive studies of limited areas, which has proved so valuable elsewhere, is enforced by the data obtained during the Clare Island survey, which added no fewer than 2,000 species of organisms to the Irish lists and 109 animals and 11 plants which were new to science.

The work is clearly intended for the general reader, in deference to whom 'popular names' for animals and plants are mainly used, sometimes at the risk of ambiguity. Occasionally unexplained technical expressions are employed which may form a stumbling-block to a few, but there is little doubt that the intelligent traveller in Ireland will find in these pages much to open his eyes to the interest of his environment. The book is illustrated with a number of excellent photographic reproductions and text figures. It is unfortunate that one of the latter, purporting to represent "diatoms from Lough Neagh," should consist almost exclusively of figures of desmids. E. J. S.

Directive Evolution

The Evolution of the Australian Merino

By E. W. Cox. Pp. xxii + 160 + 31 plates. (Sydney and London: Angus and Robertson, Ltd., 1936.) 21s.

TO the student of evolution this history of the Australian merino will be of great interest, for it not only gives a narrative of the ways in which the breed was formed, but also seeks to analyse the factors responsible for its successful development.

After tracing the history from Spain, through England, France, Austria, Germany and United States to Australia, detailed accounts are given of the development of the main flocks and lines of blood in the various Australian States. In the later chapters dealing with the ways and means

of the evolution, geneticists will find much of interest.

The history of the Australian merino forms perhaps one of the best examples of the evolution of an animal directed by man towards a certain purpose—the production of large amounts of good quality wool. What directive evolution means can be gathered from the advice given to the prospective flock master, who "must visualize the type he wishes to attain and the wool it is to grow. That 'dream-sheep' must be kept before his mind at all times."

As an example of what has been achieved by this method, the average cut in 1800 was 4 lb. for a ewe and 7 lb. for a ram, while to-day almost

any of the great studs average more than 15 lb. for a ewe and more than 20 lb. for a ram—wool, too, of better quality.

Photographs of the champion rams each year from 1895 until 1936 show clearly the changes which have taken place in the body form of the Australian merino. Progress in the development of the body and in the constitution has been marked. The hardest improvement to obtain appears to have been to increase the length of the staple without loss of the other properties, but this has been done by the gradual process of selection. The success of the outstanding Peppin stock is attributed to the founder's idea of letting the sheep develop to suit the food and climate of the country. The failure of the Vermont stock from America, after their size had led to a craze for their importation, is attributed to a lack of suitability to environmental conditions.

It is concluded that breeders should preserve and utilize by inbreeding the outstanding qualities of every excellent animal: inbreeding is the most powerful tool available to the breeder. Inbreeding of a good strain makes it possible to produce superior animals more quickly than by any system of selecting and mating unrelated animals. The behaviour of strains when submitted to inbreeding is the surest test of their worth.

As to probable future developments, the author foresees breeding in much smaller flocks, and with this the danger of the loss of uniformity which is the feature where one man has directive control over large numbers of animals. A knowledge, too, is needed of the chemical nature of the food best suited to wool growth, for the best sheep are produced on the medium grass and salt bush country and not on the rich fattening areas.

J. H.

Science and Free Will

Free Will or Determinism

By Dr. M. Davidson. Pp. xv + 203. (London: Watts and Co., 1937.) 10s. 6d. net.

IN recent years experimental work in physics has led to theoretical conceptions which suggest that the movements of atoms and electrons are just as indeterminate as human action. Yet it is doubtful if Prof. Max Planck's quantum theory will rule out determinism for those who prefer, for logical or other reasons, to hold to that view. It has not made Dr. M. Davidson or Prof. H. Levy relinquish a strictly mechanistic view of Nature. Prof. Levy, for example, argues that those who maintain that recent physical research has exposed a fundamental indeterminacy in Nature must explain away the determinism that has been established on the large scale. On the other hand, Sir Arthur Eddington asserts that "Classical physics foists a determinate scheme on us by a trick; it smuggles the unknown future into the present, trusting that we shall not press an inquiry as to whether it has become any more knowable in that way". Perhaps the truth is that if one believes in free will for other reasons—the experience of volition, for example—one is thankful for the quantum theory as a crack in the fabric of the mechanistic view of Nature. Judicious leverage may, one hopes, make it wider. Hence the anxiety in some quarters to fill it with cement.

Perhaps the best line of attack on the mechanists

is not to look for cracks in their system, but to ask whether a strictly mechanistic view has not its difficulties too, though they can be easily ignored because they lie on the surface. Is it not now coming to be recognized that the method of science is, after all, realist, not nominalist (to use the scholastic terminology)? Does science not proceed on the theory that reason and logic have a reality of their own, even apart from particulars? In a word, is not science idealist (to use modern terminology)?

In his chapter on the mechanistic view of life, Dr. Davidson seems to end up on a note of some dubiety. For while he says that Loeb and his school have pushed the problem back a long way, he adds that it still remains unsolved, though it does seem that "some day the final word on vital phenomena may be spoken by the physicist". Then he observes that, "In the present state of our knowledge we can only endorse the words of Dr. Benjamin Moore: 'In the processes of cell reproduction and division there is a type of energy at work never found elsewhere than in living organisms'." But the late Dr. Moore's doctrine of a vital force was, from the mechanistic point of view, a heresy.

Dr. Davidson has provided a useful summary of arguments in favour of holding fast by the deterministic view, though he cannot be said to have contributed anything new to the solution of the problem.

J. C. H.

Science and Common Sense:

an Aristotelian Excursion. By W. R. Thompson. Pp. vii+234. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 7s. 6d. net.

DR. THOMPSON is a biologist of distinction whose published work is characterized by depth and originality. In this book he has departed from his usual field of observation and experiment and set himself the task of examining certain aspects of present-day scientific thought. He contends that some of the paradoxical statements made in connexion with physical theory would, in other circumstances, be regarded as contrary to logic and common sense. Biologists, he says, show signs of being imbued with this same mental attitude owing to the influence of mathematical physics.

Dr. Thompson's views are developed in some eight chapters, and perhaps the most significant are those concerned with the use and abuse of mathematics and of philosophy. The concluding chapter examines certain concepts of evolution. While the doctrine of evolution is a long way from being played out, it seems to have lost much of its interest, workers to-day tending to pursue matters more capable of experimental verification. Attempts to extract from the world as it now is have not yielded the true history of its past. Without the help of philosophy, the legitimacy of the principle of evolution would be impossible to uphold. The rejection of philosophical methods and principles would ultimately turn scientific work into a mere cinematographic record of events. With reference to mathematics and biology, the author stresses that the growing tendency to restate biological problems mathematically is beginning to produce "a kind of sublimation of biological facts into mathematical figments" which are commonly believed to be their equivalents. This practice, he observes, leads to quite fallacious notions about living things.

We commend Dr. Thompson's book as a critical and suggestive analysis: it aims at showing up in proper perspective some tendencies of modern scientific thought.

Zero to Eighty:

being my *Lifetime Doings, Reflections and Inventions*, also my *Journey around the Moon*. By Akkad Pseudoman (Dr. E. F. Northrup). Pp. xii+283+15 plates. (Princeton, N.J.: Scientific Publishing Co., 1937.) 3 dollars.

It may not be generally known that there is a British Interplanetary Society and an American Rocket Society, the members of which are heralding the dawn of interplanetary travel. In his volume "*Rockets through Space*", published last year, Mr. P. E. Cleator, president of the former, has given an account of the unsuccessful attempts which have been made to make a rocket leave the earth and visit other planets. Dr. E. F. Northrup, in "*Zero to Eighty*", is very much more likely to convince us that such methods will ever succeed, for he is at great pains to give us scientific chapter and verse for every event in his imaginary journey around the moon and back.

The story is told as an autobiography—the life, inventions and reflections of a man of science, Dr. Akkad Pseudoman, living from A.D. 1920 until 2000—and is claimed to present a reasonable scientific solution to the problem of escaping from the earth's gravitational attraction and navigating projectile-ships in celestial space. Dr. Northrup's projectile acquires its huge velocity by eddy-current thrust in a long coil of special design which is excited by three-phase current. It is steered by means of rockets.

Akkad Pseudoman has all manner of adventures. He has a Russian assistant, who is claimed by the Soviet Government when all his plans are ready and who organizes a rival flight. He is kidnapped and is rescued as a result of his wife's knowledge of chemistry. He makes a fortune and is able to found a School of Associative Science where science-philosophers are trained.

Dr. Northrup's book does not, it is true, provide the general reader with such delectable fare as does Jules Verne in "*From the Earth to the Moon, and a Trip Round It*"; but the scientific reader cannot fail to be interested in the technical argument, which is expounded with striking lucidity.

River Flow Records

By Capt. W. N. McClean. Series A: River Garry. Sheet No. 1. 1s. 6d. Sheet B: River Moriston. Sheet No. 1. 1s. 6d. Series C: River Ness. Sheets 1-14. In portfolio. 15s. (London: River Flow Records, 1937.)

THE hydrological activities of the private organization known as River Flow Records (director, Capt. W. N. McClean, Parliament Mansions, S.W.1) have been in evidence for some time, and the publications under notice represent the data accumulated over a period of several years in the basin of the River Ness, Inverness-shire. Records of the River Garry, one of the tributaries of the Ness, were instituted so far back as December 1912, and then, after a prolonged interval, were resumed in 1929 on the establishment of a water-level recorder at Invergarry, with fresh measurements of flow. The survey of the River Moriston, another tributary influent, was instituted in 1929, following the rejection of the West Highland Water Power Scheme. In both cases, from July 1929 until March 1931, the records were issued quarterly in tabular form. In the present publication, they, and the complete set of records for the River Ness, are given in graphical form, based on the wider range of flow-gauging made since 1931.

It is obvious that these readings must be of great service to all who are concerned with the hydrology of the Ness Basin, as, indeed, to water engineers generally, and it is to be hoped that the organization will receive substantial public support from the purchase and circulation of these admirable charts, embodying, as they do, the results of prolonged and careful observation, carried out on scientific lines and rendered available in a compact and easily accessible form by the commendable enterprise of the undertaking.

B. C.

Air Ministry

Meteorological Office. *British Rainfall, 1936: the Seventy-sixth Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1936 as recorded by over 5,500 Observers in Great Britain and Ireland.* (M.O. 415.) Pp. xix + 292. (London: H.M. Stationery Office, 1937.) 15s. net.

THE seventy-sixth volume of this valuable report on the year's rainfall contains the usual general table of returns from about 5,500 stations in the British Isles. In addition there are sections dealing with such special subjects as droughts, wet spells, duration of rainfall, heavy falls, monthly and seasonal rainfall, evaporation and percolation. From the foreword we learn that the revised system of classification of heavy falls in short periods, described last year in a special article by Mr. E. G. Bilham, has now been introduced. The main effect of the new scheme is to exclude many falls lasting only a few minutes from the 'noteworthy' category. It is also interesting to learn that the arrangements for charting rainfall month by month have now been so greatly improved that the charts prepared for the Monthly Weather Report are accepted, without substantial revision, for publication later in "British Rainfall".

Although the rainfall of 1936 exceeded the normal by nine per cent over England and Wales, there was a marked deficiency in Scotland, amounting to twenty per cent in the Western Highlands. In a special article by Dr. J. Glasspoole, details are given of the unprecedented deficiency of rain in western Scotland during the period November 1935 to June 1936. There is also a valuable article by Mr. L. C. W. Bonacina on the snowfall of the decade 1926-35.

Die Fermente und ihre Wirkungen

Von Prof. Dr. Carl Oppenheimer. Supplement. Lief. 6 (Band 2, Spezieller Teil: Haupt-Teil 13-15). Pp. 783-942. (Den Haag: Dr. W. Junk, 1936.) 10 florins.

THE sixth part of this important supplement deals with the proteinases, in particular with tryptase, pepsinase, chymase (rennet) and also papainase: it follows the plan already indicated. Frequent use of the supplement confirms the opinions already expressed as to its utility and the clarity with which the great amount of information is presented. Sections dealing with the occurrence and distribution of these enzymes may be particularly cited for their completeness and value to the physiological chemist. Naturally, exact directions are given for the preparation of the crystalline enzymes, and one could have wished for some photographs of these crystals in order to bring home to the sceptics their beauty and the magnitude of the achievement.

Prof. Oppenheimer indicates that the completion of the supplement will occupy another year and a half, and he pleads for reprints of papers on enzymes to be sent to him so as to hasten and facilitate this reference to new work, a request which we recommend also to our readers. The address is: Berlin, W.15, Kurfürstendamm 61.

E. F. A.

British Museum (Natural History)

Catalogue of Fossil Cirripedia in the Department of Geology. Vol. 2: Cretaceous. By Thomas Henry Withers. Pp. xiv + 534 + 50 plates. (London: British Museum (Natural History), 1935.) 30s.

WHEN the first volume of this Catalogue was published in 1928, the earliest cirriped known was *Eolepas* from the Rhætic. A much earlier form has since been discovered in the middle Carboniferous of the Donetz and Kusnetz Basins, U.S.S.R. This is a Lepadomorph barnacle, and it shows that the Cirripedia must already have been in existence for a long period, but gives no evidence of the origin of the group. Among many interesting points in phylogeny the author brings forward evidence to show that the three sub-orders of the sessile Cirripedes (the Brachylepadomorpha, the Verrucomorpha and the Balanomorpha) have been derived independently from a pedunculate stock. The Cirripedes show a great development in the Chalk, where nearly a hundred species and varieties are known, but there is an unaccountable imperfection of the record in the Lower Cretaceous deposits, in which only six species have been found; this makes it difficult to connect some of the Jurassic forms with those of the Cretaceous.

The introductory chapters deal with the history of research, phylogeny, ontogeny, distribution, etc. The main part of the work is a systematic account of all the known genera and species of Cretaceous Cirripedes. The reconstructions of some of the more important forms add greatly to the interest of this comprehensive work.

Design:

a Treatise on the Discovery of Form. By Percy E. Nobbs. Pp. ix + 412. (London: Oxford University Press, 1937.) 30s. net.

THIS interesting work fills a gap in æsthetic theory, in so far as the discussion of the subject is developed by a practitioner from fact to principle. Many problems of mechanical, of psychological and of philosophical interest are involved in what seems to be the simple art of design. Illuminating suggestions are offered by the author for the solution of such problems, though he is careful not to commit himself to any particular school of thought. Gestures which seem to be innate for the artist, such as the use of scale and proportion, the materialization of ornament, the appreciation of colour and the realization of form, involve a series of elements which the author brings out and discusses with clarity and conviction.

It is in the third part of the book that the mutual process of discovering pure form is described by the consideration of a series of progressively complicated problems of accommodation. It is thus shown that the discovery of pure form is expression, but not art, and that the loss of purity in the form may be compensated for by its artistic elaboration, or by the incorporation with it of extraneous subject-matter by way of adornment. An excellent selection of illustrations gives an added emphasis to the æsthetic views put forward.

T. G.

Nutrition and Health

TWO years ago the League of Nations set up a Mixed Committee on the Problem of Nutrition, consisting of agricultural, economic and health experts, and including representatives of the Advisory Committee on Social Questions, the International Labour Organisation and the International Institute of Agriculture. An interim report was published more than a year ago, in four volumes: the report proper, a report on the physiological bases of nutrition, and volumes entitled "Nutrition in Various Countries" and "Statistics of Food Production, Consumption and Prices", the latter being compiled by the International Institute of Agriculture, Rome. The interim report was devoted primarily to explaining the new conceptions which, in the opinion of scientific investigators, should govern human nutrition, to showing the effects of disregarding these rules, and to framing recommendations which might form the guiding principles of national nutrition policies. The economic and agricultural aspects of the problem, briefly referred to in the interim report, were reserved for further treatment, and the final report, which has now been published*, is primarily concerned with them.

The report is divided into three parts: the first, which has three chapters, describes the activities of the Mixed Committee and of other international bodies working on the problem of nutrition, outlines the general trend of progress in nutrition and public health during the past century, and finally summarizes the contents and conclusions, reproducing also the recommendations published in the interim report. The second part is devoted exclusively to the health aspect of nutrition, and reproduces, with such minor modifications as recent research has made necessary, the section of the interim report dealing with nutrition and health. The third part, which constitutes the bulk of the report, deals with the economic and agricultural aspects of the nutrition problem: in its seven chapters the recent tendencies in food-consumption habits and in agricultural production are traced, the problem of food prices and the role of income in determining nutritional levels are analysed, and the part which education can play in determining food habits is considered: finally, a chapter is devoted to showing that in spite of the gradual improvement in nutrition which has taken

place in recent decades, malnutrition still exists in all countries, even in those with the highest general plane of living. The report is mainly concerned with conditions in Europe and countries with a Western civilization, since the Committee found that it would not be possible, in the time at its disposal, to obtain adequate documentation of conditions in the Far East; the Health Organisation is, however, taking measures to promote a full consideration of the problem of nutrition in this part of the world.

The advance in our knowledge of the principles of correct nutrition makes it possible to lay down with some precision what is an adequate diet in different circumstances. The report divides food-stuffs into two classes: (1) the protective foods, such as milk, glandular animal tissues, eggs, 'fat' fish, green vegetables and fresh fruit, which provide minerals, vitamins and 'good' (or animal) protein; and (2) the energy-bearing foods, such as fats, cereals and sugar. The basic figure for the energy requirement of the average adult, male or female, living an ordinary everyday life in a temperate climate and not engaged in manual work, is fixed at 2,400 calories net (that is, after deducting waste in cooking and at table) per day. It is suggested that 1,400 calories should be obtained from protective foods, and the use of highly milled cereals and an excessive amount of sugar in the diet is deprecated: special attention is directed to the value of the potato as a food rich in calories and in starch, which is particularly suited as a substitute for sugar and cereals in the modern European diet. Among the protective foods special emphasis is laid on the need for milk in the human dietary and on the value of fish liver oils as supplements for their content in vitamins A and D.

The report directs attention to the improvement in nutrition and public health during the past century, owing to the improvements in economic welfare and sanitation and to the advances in medical knowledge, and presents statistics to show that in all Western countries the average diet of the population has become increasingly diversified during recent decades, with a definite tendency, stronger in some countries than in others, but everywhere present, for the consumption of protective foods to increase, and for that of the purely energy-bearing foods, such as cereals and potatoes, to decrease. The changing content of the diet is not an accident: it corresponds to a genuine change both in physiological requirements and in the power to satisfy them.

* Nutrition. Final Report of the Mixed Committee of the League of Nations on the Relation of Nutrition to Health, Agriculture and Economic Policy. (Official No.: A. 18, 1937, II, A.) Pp. 327. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1937.) 7s. 6d.

The principal cause is the reduction in the expenditure of muscular energy, brought about by the increased mechanization of industry and agriculture and the reduction of the hours of work, and by the rise in the proportion of the population engaged in commerce, clerical work and other quasi-sedentary occupations. Simultaneously, mechanization has increased output per head and raised the purchasing power of all classes of the population. Nor must the improvements in the methods of production and distribution of agricultural products—for example, by the widespread use of refrigeration—be left out of account.

Although the diet of most Western countries has improved very considerably during the past twenty or thirty years, and consumption habits are tending to change along the right lines, yet the report adduces evidence that, even in those countries where the improvement in dietary habits has been most marked, the diet of a substantial proportion of the population remains deficient in essential nutritive elements. Reference is made to evidences of malnutrition, when the dietary needs of different classes of the population are considered, such as expectant and nursing mothers, infants, children and adolescents, as well as adults; whilst a special chapter at the end of the report gives statistical evidence for the statement that malnutrition still exists in countries of the most diverse social structure and stage of economic development. Such malnutrition need not result in the appearance of frank 'deficiency diseases' among the population; in fact, the report emphasizes that, although preventive action against such diseases as scurvy, rickets and beriberi is impressive, yet it is probably of less importance to the human race than the acquisition and application of such knowledge as will also improve the general condition and well-being of every man, woman and child, through the better choice, provision and utilization of foodstuffs.

Almost half the report is devoted to the effects of changing habits of food consumption upon agriculture and the economic aspects of the question of improving nutrition, including the relationship between food prices and consumption and factors affecting the former. It is pointed out that agriculture has had no difficulty in meeting the changes in food consumption which have occurred during the past few decades, and that the adjustments necessary in the future should not be impossible, although certain difficulties exist; moreover, the change in dietary habits to which the report looks forward will be steady and gradual. Although it is likely that the demand for the protective foods will rise, yet it is considered that a considerable increase in the consumption of foods of high energy value will be required to bring the

calorie content of the diet of certain sections of the population of a very large number of countries up to standards of adequacy. The increase in the demand for energy-bearing foods will more than counterbalance the decrease which accompanies an increased demand for protective foods. Also, as in the classical case of Denmark, a shift from exportation of cereals to dairying and animal husbandry need not mean a reduction in cereal cultivation; in fact, the output of cereals was increased owing to their demand for animal feed.

The obstacles in the way of adaptation of production to the new consumption trends are shown to be natural conditions, the conservatism of producers, commercial policy and penury of capital, as well as the perishable nature of many of the protective foods; wise and sympathetic consideration will overcome many of them. It is pointed out also that the contribution of agriculture to improved nutrition has not been merely adaptive only. The application of science to agriculture has produced a technical revolution parallel to, though less spectacular than, the industrial revolution. Mechanical processes have replaced hand-labour and the application of biological and chemical science has resulted in the improvement of both plants and animals or animal products used for food. Thus the breeding in Canada of Marquis wheat, which ripens early, has added 100 million acres to the potential wheat belt of Canada alone, by extending it northwards, and the annual milk yield per cow in most countries has been enormously increased. Even if, during the next five years, no further new discoveries were made but intensive national efforts were concentrated on securing the application of existing knowledge, the results on agricultural prosperity and nutritional standards would be enormous.

Turning now to the influence of food prices upon consumption, the report points out that the relationship varies in the case of different foodstuffs. Thus the demand for butter is elastic, consumption increasing markedly in recent years in countries where the price has been relatively low; in Great Britain during the years 1923-33, whatever the price prevailing, a rise or fall in the price of butter of 1d. per lb. decreased or increased demand by 39,000 cwt.; and a rise or fall in the price of cheese of 1d. per lb. similarly decreased or increased demand by 133,000 cwt. The 'elasticity', therefore (that is, relation of proportionate change in demand to proportionate change in price) was greater when consumption was low (and prices high) than when consumption was high (and prices low). In the case of milk, the response of consumption to changes in price has been found to be fairly low; and the same is also true of cereals. The demand for bread is inelastic, since the first

desire of the consumer is to satisfy his hunger ; and even though bread prices are kept high, bread generally still remains the cheapest way of doing this. Paying more for the bread he eats is equivalent to a reduction in the real income of the consumer, with the result that his purchases of the higher-priced protective foods are restricted, with consequent deterioration of the diet.

Evidence is adduced, in the chapter on the relation of income to nutrition, that usually the sources of 'good' protein and foods rich in minerals and vitamins are more expensive than the purely energy-bearing foods. This applies particularly to fruit, vegetables, meat, fish and eggs ; while dairy products—also 'highly' protective—occupy an intermediate position. These foods, though expensive as sources of calories, are relatively cheap as sources of minerals and vitamins ; their expense, however, militates against their consumption by the poorer sections of any community. With rising income, calories are purchased from more varied and expensive sources, which are usually more nutritive ; thus a steady increase in the percentage of both proteins and calories derived from animal sources has been found to accompany a rising income per consumption unit. The evidence for the existence of malnutrition in many countries is supplemented by studies of the cost of adequate diets, which

disclose the fact that the incomes of the poorer sections of the population are actually insufficient to provide their members with a minimum adequate diet.

Finally, the report gives consideration to methods of improving nutrition ; it insists, in the first place, that the problem must be recognized as one of primary national importance. It recommends the establishment in each country of National Nutrition Committees, containing scientific investigators, economists, agricultural experts, consumers' representatives, teachers and administrators, which would initiate investigations into the facts of nutrition, educate the consumers and make recommendations for improving the national diet. The report recommends the extension of social legislation for the protection and improvement of the health of the people, and directs attention to the value of school meals and to methods for increasing the consumption of milk. Policy must also be directed towards helping the orderly expansion of agriculture and its adaptation to the changing demand ; at the same time, attention must be given to improvement of transport and distribution, with the view of reducing the margin between the price received by the producer and that paid by the consumer. Adequate nutrition must be one of the factors considered by each country in determining its economic policy.

Investigation of the Upper Air

AT the Nottingham meeting of the British Association a discussion on the upper air which was held on the morning of September 6 was preceded by a demonstration of the ascent of a sounding balloon, organized by Prof. D. Brunt. The demonstration attracted the attention of large numbers of members of the Association, as well as of the general public. The balloon carried a Dines meteorograph, recording pressure, temperature and humidity at all stages of the ascent. The instrument was attached to the balloon by a Baker release, which consists of a small aneroid box with a catch capable of being set so that it is released from the balloon at any desired height. In the demonstration the catch was set to liberate the instruments at a height of about 12 kilometres.

The instruments were in fact released from a height of 12.3 km., and were found 4 miles east of Grantham and returned to Kew Observatory in good condition. The record of the meteorograph showed that the balloon had probably entered the stratosphere at a height of 12 km., where the

temperature was -55°C . The temperature fell steadily through the whole range of height attained, except in a layer from $\frac{1}{2}$ to 1 km. above the ground, where it increased by about 1°C . The record of humidity, which was probably only reliable in the lower half of the ascent, showed no features of particular interest. The general features of the temperature record agreed with those shown by the aeroplane ascent at Mildenhall on the same morning.

In the subsequent discussion in Section A, Prof. D. Brunt explained the division of the atmosphere into troposphere and stratosphere, and explained why frequent measurements of temperature and humidity in the free air are of importance to the forecaster. The method demonstrated before the meeting has the disadvantage that days or even weeks may elapse before the record of the Dines meteorograph, or any other instrument sent up on a free balloon, is available for study. The alternative method of upper air observation which is in general use in

meteorological services is that of observing from an aeroplane. This method is expensive and is restricted to those days when it is possible for an aeroplane to fly. In consequence, efforts are now being made to develop wireless methods.

Mr. L. H. G. Dines, of Kew Observatory, described the meteorograph in greater detail, and showed a number of specimen records obtained by its use. On account of the lightness of the instrument, it can be sent up with any other instruments used for the investigation of conditions in the upper air.

Prof. K. O. Lange, of Blue Hill Observatory, Harvard University, described a wireless transmitter which has been developed at Blue Hill, for use on balloons in conjunction with a receiver at the ground. The transmitter sends out waves of constant frequency, and the aim of the designer of the instrument is to replace the measures of the meteorological elements by time intervals. The meteorological instruments are an aneroid, a bimetallic thermometer and a hygrometer. Each of these instruments is equipped with a pen arm, and these pen arms, together with a fixed pen, slide over a small cylinder on which is wound a fine platinum wire in the form of a helix. The helix and the pens are wired to the transmitter, and the cylinder on which the helix is wound is rotated by a clockwork which makes two revolutions per minute. The contacts of the fixed pen with the helix bring the transmitter into action at regular intervals of $\frac{1}{2}$ minute, while the pens attached to the meteorological instruments bring the transmitter into action at times which are determined by the readings of these instruments. The signals being recorded on the drum of a chronograph, the lags between the records given by the moveable pens and the fixed pen are readily estimated and converted into the readings of the corresponding meteorological element.

The instrument shown by Prof. Lange is extremely compact, being contained in a small wooden box, the external dimensions of which do not exceed 8 in. \times 4 in. \times 3 in. This method is now being adopted at some of the upper air stations in the United States, instead of the aeroplane ascents which have hitherto provided the data required for weather forecasting. It is likely that the same or similar instruments will be in general use in many parts of the world within a few years, in view of the saving of money, combined with the enormously increased frequency of observations, which will be obtained when this method supplants the aeroplane. The use of such instruments will open up the possibility of obtaining observations of the conditions in the central part of depressions and in other conditions when it is impossible for an aeroplane to make an ascent, as in rain or fog.

Prof. F. A. Paneth, in continuing the discussion, explained the methods by which he and Mr. Dines had obtained samples of air at high levels in the atmosphere, and showed some of the results of analysing these samples. The most interesting result so far obtained is the apparent increase in the proportion of helium present in air at levels of 25 km. and upward, indicating a tendency for the component gases of the atmosphere to separate out according to their molecular weights at such levels in the atmosphere. Further observations will be required before this can be accepted as conclusively proved. Prof. Paneth emphasized the importance of analysing samples of air from high levels for their water-vapour content. In view of the fact that nearly all the radiation and absorption of long-wave radiation in the atmosphere are produced by water vapour, it is of the greatest interest to meteorologists to know how much water vapour actually is present at high levels in the atmosphere.

D. B.

The Percy Sladen Expedition to Lake Titicaca*

By H. C. Gilson, Leader of the Expedition

SINCE April 14, the day after the arrival of the main body at Puno, the Expedition has been established in a hacienda (Camjata) on the peninsula of Capachica, which bounds the north side of Puno Bay (see Fig. 1). The first fortnight was spent settling in, arranging laboratory

accommodation, and transporting all our numerous cases of apparatus and equipment out from Puno, a four-hour trip by motor launch. During this time a good deal of miscellaneous collecting was done in the ponds and streams of the peninsula, but it was not until the beginning of May that work on the lake could be started in earnest. Since then routine hydrographical and chemical observations

* See also the article by Prof. J. Stanley Gardiner in NATURE of Feb. 27, 1937, p. 342.

have been made at a station about four miles out from the anchorage, besides numerous trips farther afield. An intensive faunistic and ecological study has been made of the anchorage and neighbouring bays, also supplemented by expeditions to other shores of the lake.

The hydrography of the lake is somewhat complicated, and no certain conclusions as to the water movements can be drawn from our work as yet. It can be seen from Fig. 2, which shows temperature profiles for the same station at different dates, that during the two and a half months of our observations there has been a steady loss of heat from the lake as a whole. At the same time the thermocline has moved down from 60 metres to 100 metres and its temperature difference has decreased. The causes of these two changes are presumably to be found in the considerable radiation which occurs during the nights, which are almost always clear at this season, and in mixing by the wind. The latter has not been strong, averaging 9.4 m.p.h. in May, 8.8 m.p.h. in June, and 9.5 m.p.h. in the first half of July, but higher velocities have probably been reached for short periods in July than in the preceding months.

The lake water is distinctly alkaline, the pH varying from about 8.5 in the surface layers to 7.75 at the bottom. It has a comparatively high content of solutes, the chloride alone ranging from 245 to 250 parts per million. The alkali reserve shows small variations about 0.0023 *N*, being generally rather lower in the illuminated zone. Of the nutrient salts, silicate ranges from 300 mgm. to 800 mgm. Si per cubic metre in the photosynthetic zone, and rises to 2,000 mgm. Si in the

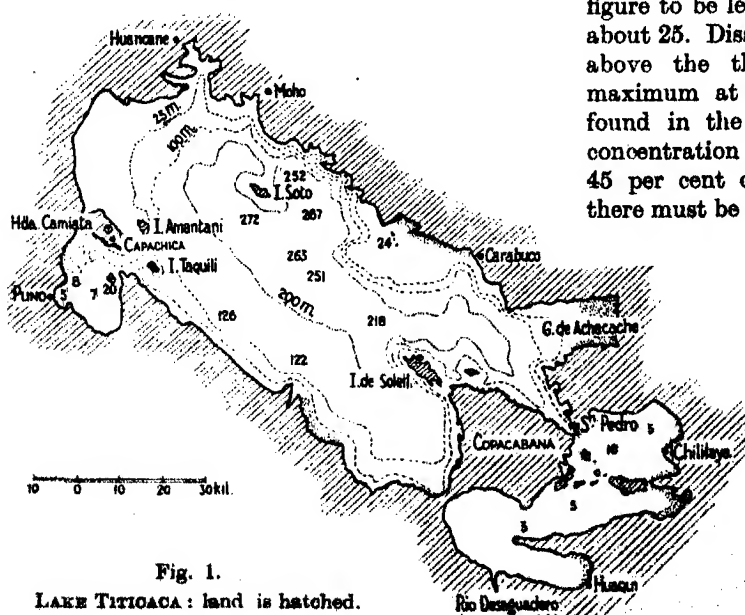


Fig. 1.
LAKE TITICACA: land is hatched.

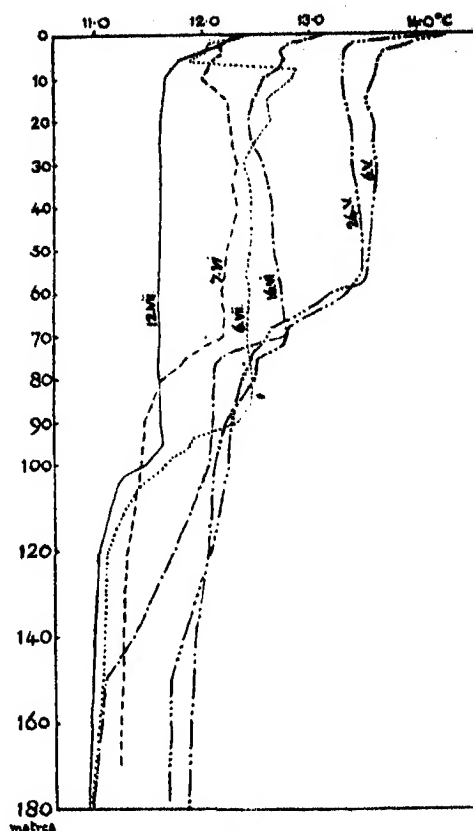


Fig. 2.
TEMPERATURE PROFILES AT A STATION IN LAKE TITICACA.

depths; phosphate shows a similar reduction in the surface layers where it never exceeds 15 mgm. P/m.³, but depletion by the plankton is by no means complete, as we have never found this figure to be less than 7; in deep water it rises to about 25. Dissolved oxygen approaches saturation above the thermocline, frequently showing a maximum at 5 or 10 metres, as is commonly found in the sea. Below the thermocline the concentration is lower but never falls below 45 per cent of saturation, which suggests that there must be complete circulation at some time of the year. An experiment with raw plankton gave the 'compensation point' at 13 metres, but the true level is probably somewhat lower.

Plankton is abundant, the principal plankton animal being a species of *Diaptomus*. Early in the season a daphnid was also present in considerable numbers, but later gave place to a small chydorid. Several species of rotifer are also common. The dominant phytoplankton forms

are a diatom and a colonial green alga resembling *Dictyosphaerium*. The latter is abundant at all depths down to 50 metres; the diatom is found alive down to 15 metres, but below this there are only dead shells. The less common forms show an interesting vertical distribution. Thus from 10 to 20 metres *Lagerheimia* sp. (Chlorococcales) and *Chlamydomonas* sp. occur; from 20 to 30 metres *Oocystis* sp. (Chlorococcales) is found and *Peridinium* sp. in small numbers; from 30 to 40 metres the *Peridinium* is common with *Staurostrum* sp. (Desmidiaceæ); from 40 to 50 metres there is little alive except the *Dictyosphaerium* and *Peridinium*.

Round the shores the rooted vegetation varies considerably with depth, exposure and type of bottom. In all sheltered places where the depth is between 1 and 4 metres, such as the major part of Puno Bay, there is a thick growth of "tortora" (*Scirpus riparius*). Underneath this and elsewhere is a mixed smaller vegetation which shows a marked zonation with depth. Thus in moderate shelter from 0.2 to 0.5 metre *Zannichellia* sp. is dominant; from 0.5 to 8 metres there is a mixed vegetation of *Potamogeton*, *Elodea* and *Myriophyllum*; from 8 to 13.5 metres *Chara* sp. is dominant; from 13.5 to 17 metres this is replaced by a moss. With greater exposure the zones tend to be shifted downwards, perhaps owing to the harder bottom and consequently clearer water found there.

The fauna of the lake is rich in individuals, but species are not numerous. No Isopoda, Neuroptera, Plecoptera, Hydrometridæ or Gerridæ have been found.

In the "tortora" swamp occur *Notonecta* and the water beetles *Agabus* and *Trophisternus*. The same species of these genera are also present in ponds near the lake. In the belt of low-growing weeds which fringes the shores down to a depth of about 10 metres, the most abundant animals are several species of *Hyalella* (Amphipoda) and *Littoridina* (Mollusca). Besides these, *Turbellaria*, *Oligochaeta*, *Platyphius* (a ramshorn snail), *Ancylus* (a freshwater limpet), *Pisidium*, *Sphaerium*, leeches, water mites, *Corixidæ* and the larvæ of caddis flies, *Chironomidæ* and dryopid beetles are usually found. A green sponge is common, growing on plant stems. A similar fauna is present in the shallow lagoons near the north end of the lake.

On bare stony bottoms *Hyalella* is dominant, as many as 1,500 having been counted to the square foot. Below the 10-metre line the bottom is usually muddy and contains *Platyphius* and *Hyalella* (different species from those in the weed), *Pisidium*, leeches, chironomid larvæ and sponges.

There are in the lake a number of species of

Orestias (a Cyprinoid fish), a large catfish, and an aquatic frog (*Cyclorhamphus*). The catfish is also found in the larger rivers which run into the lake, and in these it is fished commercially.

In the smaller streams near the lake and the headwaters of the rivers are numerous beetles, larvæ of dragonflies and mayflies, *Planorbis*, *Sphaerium* and *Hyalella*. The same species of *Planorbis* has been found near Cuzco in the Amazon basin; and the same, or a closely related, species of *Hyalella* as far down as Quillobamba

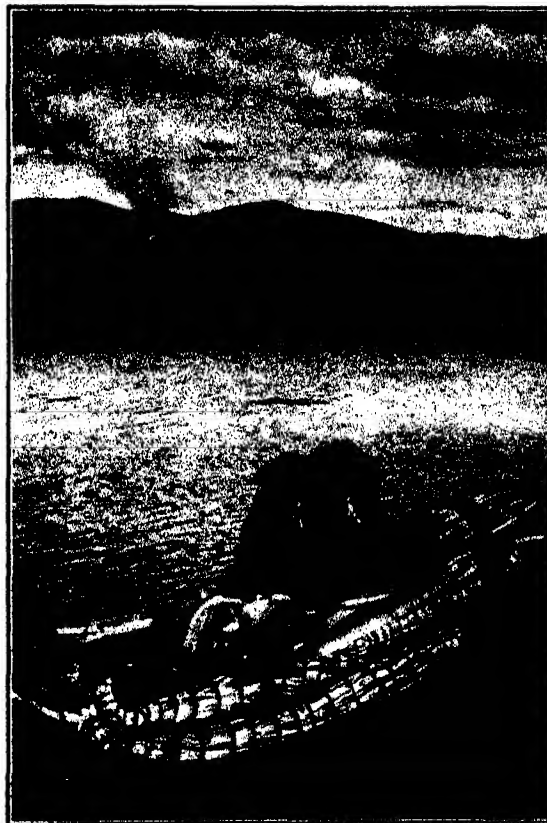


Fig. 3.

NATIVE BOAT WITH WOMEN WEARING A TYPE OF HAT COMMON IN COUNTRY DISTRICTS NEAR LAKE TITIGACA.

(3,600 feet) in the Amazon basin, as well as at San Antonio (15,500 feet) in the Pacific drainage area. In some of the temporary ponds near our base a species of *Estheria* (Conchostraca) was abundant until they dried up.

Besides the field work, the results of which are very briefly summarized above, a good deal of laboratory work has also been done. Hinton has worked out the life-histories of nearly all the important insects, besides making extensive collections of the terrestrial insect fauna. Collections have also been made of many of the birds and their parasites.

I am much indebted to all my colleagues for their wholehearted co-operation in all the work of the Expedition and for much of the information contained in this article. We are also indebted to Señor Carlos Landaeta B. for allowing us to

use the Hacienda Camjata as our base, and to the officials of the Peruvian Corporation in Puno and Arequipa for arranging our food supplies and helping us in innumerable other ways. We gratefully acknowledge the help thus afforded the Expedition.

Obituary Notices

Prof. Frank Morley

FRANK MORLEY, professor emeritus of mathematics at Johns Hopkins University, died at Baltimore on October 17. He was born in 1860 at Woodbridge in Suffolk, and was educated at Woodbridge School until he went into residence at Cambridge in 1879, having won an open scholarship at King's College. His university career was sorely hampered by illness. He did not graduate until 1884, a year later than the normal date, eighth in the list when G. B. Mathews was senior wrangler and A. N. Whitehead fifth. Ill-health beyond all doubt had prevented him from doing himself justice, but the disappointment was keen. In middle life he was loth to speak of his student days, yet the friendships then formed with Lowes Dickinson and others were lasting. It is saddening to contrast the conditions of sixty years ago with the encouragement and the opportunities that are offered to a clever boy to-day.

For three years after leaving Cambridge, Morley was a master at Bath College. Then, by the good offices of Dr. Rendel Harris, Morley (whose parents were Quakers) became professor at the Quaker College of Haverford, Pa. From then onwards his home was in America. The hardships of his earlier years were behind him; his health no longer caused him anxiety, though he was always cautious; he married, feeling that his position was assured, and lived in Haverford for twelve years, years of great happiness, during which his powers and his reputation steadily increased. His closest mathematical associations were with two Cambridge professors at the neighbouring college of Bryn Mawr, Charlotte Scott from Girton College, one of the foremost of the younger geometers, and James Harkness of Trinity College, who collaborated with him in his first book, a treatise on the theory of functions published in 1893, and reissued six years later in a shortened and much improved form as an introduction to that subject.

In 1900, Frank Morley accepted the professorship of mathematics at Johns Hopkins University, Baltimore; this he held until he reached the age of retirement nearly thirty years later. His election to this famous chair, always associated in Britain with the name of J. J. Sylvester, was an honour that could scarcely be surpassed. Other honours were bestowed upon him as the years passed by; they will not be catalogued here. He filled his high office and performed its duties with dignity and distinction.

At Johns Hopkins the work was more onerous and the responsibilities were greater than at Haverford; it is not unreasonable to feel regret that Morley's output of original papers was thereby lessened, for it is in these that his most characteristic work is to be found. As a boy and a young man Morley had shown exceptional promise as a chess-player; throughout his life he could grasp the possibilities of a position at chess or of a hand at cards with astonishing ease and certainty. He had something of the same power in discussing a geometrical configuration, for he proved, not once but many times, that he could penetrate more deeply into its inner significance than the rest of us.

There can be no doubt that the life Prof. Morley loved best was the quiet life of the student, a simple home life with friends near at hand. His elevation to the prominence of the professorship at Johns Hopkins University was a well-deserved honour, but whether it added to his happiness is doubtful. He never allowed himself to lose touch with England; it was his habit to come in alternate years, but after his retirement in 1928 he came every year; always if possible making a stay at both Woodbridge and Cambridge. A few years ago he was stricken with a serious illness while at sea on the way to England, and never wholly recovered his strength. This year he had a heart attack at sea while returning to America, and died peacefully soon after reaching his home at Baltimore.

Prof. Morley leaves a widow and three sons, all of whom were Rhodes scholars at Oxford.

HERBERT W. RICHMOND.

Prof. H. Jacobi

THE death is reported of Prof. Hermann Jacobi, emeritus professor of Sanskrit in the University of Bonn, which took place at Bonn on October 20 at the age of eighty-seven years.

Jacobi's early researches relating to Indian culture and religion dealt with the then little understood cult of Jainism. When quite a young man he accompanied Dr. Buhler, who was a member of the Bombay Educational Service, to Jaisalmer and other centres of Jain learning. He then made a profound study of the cult; and in consequence it was he who was mainly instrumental in securing the recognition in Europe and America of Jainism as an important religious system quite independent of Buddhism, of

which it was then supposed erroneously to be a mere offshoot. His translation of the Jain Sutras appeared in the Sacred Books of the East edited by Max Müller; and in 1879 he published an edition of the Kalpa Sutra, the recognized manual of the community, with an English introduction. He also edited three important Prakrit texts, which appeared at intervals between 1883 and 1923 in the "Bibliotheca Indica". He was the first to give Apabhramsa texts, which mark the transition from Prakrit to modern languages. His collection of Jain tales (1930) is in general use as a text-book. In 1913 Jacobi revisited India to lecture before the University of Calcutta on Indian rhetoric. His reception by Jain pandits on that occasion not only threw open to him material usually not accessible to foreigners, but also manifested the high esteem in which he was held in the Jain community.

Jacobi's contributions to Sanskrit learning were no less important and covered a wide field, including the study of the Indian doctrine of poetics, the Ramayana and Mahabharata, to which he is the most authoritative guide, and Indian chronology, a subject in which his studies in the *Indian Antiquary* of 1888 and *Epigraphica Indica* of 1892, with further tables published two years later, are the fundamental calculations for all later work. In comparative philology he developed important theories as regards the characteristics of certain Asiatic languages as compared with the Indo-European group. He was also an authority of the first rank on Indian philosophy, an important study being "The Origin of Buddhism from the Sankhya Yoga" (1896).

Jacobi's eminence as an Oriental scholar was recognized on the occasion of his seventy-fifth birthday, on February 11, 1925, when he was the recipient of a volume of contributions from forty-seven prominent Orientalists, among whom Britain was represented by Sir George Grierson, Dr. F. W. Thomas and Prof. R. L. Turner.

Mr. A. B. Brewster

WE regret to record the death of Mr. A. B. Brewster, formerly Governor's Commissioner of Colo, North and East Fiji, which took place at Bath on October 13 at the age of eighty-two years.

Adolph Brewster Brewster was born in Melbourne and educated in England. On his return to Australia, with his father in 1870 he took up a land grant in Fiji from the Polynesian Company, which had acquired a large concession of land around Suva from King Cakobau (Thakombau). On the failure of his venture in cotton and sugar planting, he entered the Fijian Civil Service in 1884, and served until his retirement in 1910.

Later, as Governor's Commissioner of the mountain provinces of Vitilevu, Brewster acquired an intimate and sympathetic knowledge of the wild mountaineers and their customs, of which he gave a vivid and detailed account in his book "The Hill Tribes of Fiji". He was also the author of "King of the Cannibal Islands", which appeared recently. It was through

a letter written by him to *The Times* that the war club presented to Queen Victoria by King Cakobau was returned to Fiji in 1932 to serve as the mace of the Legislative Council. A further service to Fijian studies, for which posterity will be grateful, was the compilation of a manuscript record of a native version of the organization of Fijian society, which was undertaken at his request by a native clerk, preserving a tradition which otherwise would have died out.

Mrs. F. Ll. Griffith

WE regret to record the death of Mrs. Griffith, widow of the late Francis Ll. Griffith, professor of Egyptology in the University of Oxford, which took place at Oxford on October 21 at the age of sixty-four years. Mrs. Griffith became interested in Egyptology after a visit to Egypt in 1906, and studied under Prof. Griffith, whom she married in 1909. From that time onward she was closely associated with her husband in his archaeological and linguistic studies, and accompanied him on his expeditions of archaeological investigation in Egypt, Nubia and the Sudan in 1910-13, 1923, 1929 and 1930. After his death in 1934, she devoted herself to superintending and herself working at the numerous undertakings which he had planned, but had left uncompleted. She had already published two volumes of the "Demotic Graffiti in the Dodekaschænus", of which the seventy plates were prepared by herself. She also actively supported by the expenditure of time and money the further excavations at Firka and Kawa in the Sudan in connexion with the Oxford Excavations in Nubia, a trust which had been founded by her husband in 1910.

MR. HERBERT WILLIAM ENGLAND, who died at the age of fifty-five years on October 30, had for nearly forty years been in charge of the departmental library of the Zoological Department of the British Museum (Natural History). Mr. England possessed an unrivalled knowledge of zoological literature and will be greatly missed by the many zoologists at whose disposal his knowledge and his ability in tracing obscure references were freely placed. He entered the Museum service as a boy attendant in February 1898 and attained the rank of higher grade technical assistant in 1932. Among his colleagues his kindly, helpful and generous character was well known, and the high regard in which he was held in the Museum is illustrated by the fact that he was one of the three recipients among the Museum staff of the King's Coronation Medal.

WE regret to announce the following deaths:

Sir Joseph Isherwood, Bt., who devised the longitudinal framing method for the construction of cargo boats and tankers, on October 24, aged sixty-seven years.

Prof. J. B. Senderens, *correspondant* of the Section of Chemistry of the Paris Academy of Sciences and honorary fellow of the Chemical Society, aged eighty-one years.

News and Views

Nobel Prize for Physics

THE formulation of de Broglie's wave-particle theory in 1924 and its experimental verification in 1927 by Dr. C. J. Davisson at New York and Prof. G. P. Thomson at Aberdeen mark an outstanding epoch in the history of physics. With the award of the Nobel Prize for Physics for 1937 to Dr. Davisson and Prof. Thomson just announced, all three are now in the select ranks of Nobel prize winners. The scattering of an electron beam was first studied by Campbell Swinton so far back as 1899, and had it not been for the fact that he used a polycrystalline instead of a single crystal reflecting surface, he might well have discovered the wave-like interaction of electrons with matter. The results of the many further observations on the scattering of electrons were all found to be in accordance with classical or quantum mechanics until, in 1921, Davisson and Kunaman recorded directions of preferential scattering of an electron beam from a polycrystalline surface which, however, they explained in terms of pure particle mechanics. Although L. de Broglie had formulated his theory associating wave systems with moving particles in 1924, it appears to have been rather the stimulus of an accidental observation which led C. J. Davisson and L. H. Germer to study the scattering of slow electrons from the surface of a single nickel crystal, and in March 1927 they gave a preliminary summary of their results. This was followed in December of the same year by a more complete account, which established for the first time the wave properties of moving electrons, in agreement with de Broglie's theory.

MEANWHILE, in Aberdeen, G. P. Thomson and the late A. Reid, unaware of Davisson and Germer's experiments, had been studying the scattering of fast electrons by thin films, and in May 1927 they published an account of the diffraction of cathode rays by a thin film of celluloid, illustrated by a photographic record of the distribution of the scattered electrons. It is interesting to note that here again, although he was acquainted with de Broglie's theory, it was not so much this as certain anomalous results relating to the scattering of electrons in helium observed by Dymond, and Thomson's own experiments on the scattering of positive rays in gases, which afforded the main stimulus to the carrying out of his experiments. Shortly afterwards, Thomson published the results of further experiments on the diffraction of fast electrons by thin metal films which quantitatively confirmed de Broglie's relationship. Since 1928, Davisson and Thomson have, with their respective collaborators, greatly extended their epoch-making researches, and to Thomson is due the merit of having early recognized the outstanding possibilities in the study of surface problems of electron diffraction by fast electrons with photographic

recording of the scattering angles. To-day the electron diffraction camera ranks with the microscope, the spectrograph and X-rays as an indispensable unit in the well-equipped chemical or physical laboratory.

Nobel Prize for Chemistry

Prof. W. N. Haworth, of Birmingham, and Prof. Paul Karrer, of Zurich, have been awarded jointly the Nobel Prize for Chemistry for 1937. Prof. Haworth is Director of the Chemistry Laboratories of the University of Birmingham, now provided with the most modern chemistry department in Great Britain through a generous benefactor who has recognized the value and possibilities of Prof. Haworth's investigations. He is a Davy medallist of the Royal Society and Longstaff medallist of the Chemical Society. For many years his name has been associated with outstanding results obtained in his laboratories in the elucidation by chemical and physical methods of the constitution of substances of biochemical importance, particularly the sugars and polysaccharides and, more recently, as the notice of the award indicates, with the synthesis and determination of the constitution of the antiscorbutic vitamin C to which he assigned the name of ascorbic acid. With this later work, other names are also associated, particularly those of Prof. A. Szent-Györgyi, who has received the Nobel Prize for Medicine, and Prof. E. L. Hirst, of Bristol, who has long been associated with Prof. Haworth. Prof. Haworth's name will remain outstanding in classical organic chemistry. The success of his work is due in no small measure to his great ability in organizing and leading a team of loyal collaborators, which calls forth qualities as necessary in modern chemical investigations as those required for carrying out the investigations themselves. Of this loyal collaboration Prof. Haworth has never ceased to express his appreciation whenever he has had occasion to describe the results of investigations in laboratories of which he has had charge.

Prof. Paul Karrer has published many papers on vitamins A and B and related compounds; he also confirmed the constitution ascribed to ascorbic acid by Szent-Györgyi. Karrer is perhaps best known for his investigations on the carotinoids, of which β -carotene acts as the chief precursor of vitamin A in the animal body, although α - and γ -carotene and cryptoxanthine can also act as pro-vitamins to a certain extent. More recently he has turned his attention to vitamin B₁ and the chemistry of the flavins, one of which, lactoflavin, is a part of the complex originally described as vitamin B₂, and also a part of the yellow oxidizing enzyme, in which, as the phosphate, it appears to be combined with the colloidal carrier of the enzyme. Finally, in one of his most recent papers, he and Solomán describe the

isolation of some new sterols from the unsaponifiable matter of wheat-germ oil by fractionation by adsorption on a column of aluminium oxide; the fraction of unsaponifiable matter used was assumed to contain vitamin E.

Prof. Charles Fabry, For.Mem.R.S.

AFTER fifty years devoted to teaching and research, Prof. Charles Fabry is retiring from the chair he has held in the Sorbonne, Paris. In his scientific career, Prof. Ch. Fabry has been pre-eminent for his work in optics. His interferometric work, with his determination (with Pérot and Benoit) of the length of the standard metre in wave-lengths of the monochromatic radiation of cadmium, has long been classical. His studies on the spectrum of the iron arc, his pioneer work on the mercury arc lamp, and on the application of interferometry to spectroscopic research must also be recalled. To a somewhat later period belong his researches in photometry and astrophysics. The microphotometer he designed with Prof. H. Buisson, and his studies on photographic density also represent pioneer work in a field which has since seen a wide development along the lines he predicted. During recent years, Prof. Fabry's interest has turned towards meteorological optics. Under his direction, researches on the composition of the upper atmosphere and its ozone content are being carried on by a group of his pupils. Soon after the Great War, Prof. Fabry founded in Paris the Institut d'Optique, of which he is still director. The activity of this institution has been devoted to industrial optics as well as to scientific investigation, to teaching and to the designing of optical parts as well as to research. The *Revue d'Optique*, also founded by Prof. Fabry, is published by the Institut d'Optique.

PROF. FABRY is also a brilliant writer and a lecturer of no ordinary skill. His text-books on electricity, thermodynamics, photometry, written in an exceptionally lucid style, are classics in the French universities. As a lecturer he was, at the Sorbonne, unrivalled; generations of students have listened to his witty and genial lectures and marvelled at the clarity and directness of his exposition. He is also well known in English-speaking scientific circles and is a foreign member of the Royal Society. He has delivered the Guthrie Lecture and Thomas Young Oration before the Physical Society; he is an honorary member of many scientific bodies, and recently has been elected president of the International Council of Scientific Unions. The scientific jubilee of Prof. Fabry will be celebrated by a meeting to be held at the Sorbonne some time between November 23 and December 5, and the committee dealing with the arrangements has also approved the design of a Fabry Jubilee Medal, a replica of which can be obtained from the Secretary and Treasurer of the Committee, Prof. G. A. Boutry, Conservatoire des Arts et Métiers, 292 rue St.-Martin, Paris (3ème). It is also hoped to be able to publish in volume form some of Prof. Fabry's works, selected from his classical memoirs and from his unprinted researches.

Dr. Eric Ashby

DR. ERIC ASHBY, reader in botany in the University of Bristol since 1935, has been appointed to the chair of botany in the University of Sydney, Australia, in succession to Prof. T. G. B. Osborn. After leaving the City of London School, Dr. Ashby entered the Imperial College of Science in 1923, graduating in 1925. From this time dates the origin of his original investigations, which have been pursued steadily along two main lines: a quantitative study of the effects of the environmental factors and their interactions on the growth of *Lemna*, and the analysis of hybrid vigour. Papers on both these topics have appeared in the *Annals of Botany*. In 1929 he secured a Commonwealth fellowship and widened his scientific outlook by two years work in the United States. Shortly after his return he was awarded the D.Sc. of the University of London. Dr. Ashby has played a prominent part in the development of a quantitative ecology and has surveyed this subject in botanical reviews. His highly individual view on the nature of heterosis has aroused general interest if not general approbation. His point of view is succinctly expressed in a contribution to the Royal Society on the theory of heterosis. Dr. Ashby has served botanical science in various capacities on the councils of the Linnean and Ecological Societies, and as the joint secretary of the Society of Experimental Biologists. His great talents and enterprise have gained due recognition in securing at the early age of thirty-three years an appointment of such distinction.

Geological Society: Foreign Fellows and Correspondents

AT its meeting on November 3, the Geological Society of London elected as Foreign Fellows, Dr. W. A. J. M. van Waterschoot van der Gracht, Dr. W. J. Jongmans, Dr. A. Renier, and Dr. F. E. Wright, and as Foreign Correspondents, Prof. N. L. Bowen, Prof. R. M. Field, Baron F. von Huene, and Prof. H. Stille. Dr. W. A. J. M. van Waterschoot van der Gracht, of Heerlen, has made important contributions to our knowledge of the underground geology of the Netherlands, and has also published papers on economic geology, including coal and petroleum. More recently he has devoted attention to tectonic geology with special reference to North America. His review of the theory of continental drift formed the introduction to a symposium on that subject which was published by the American Association of Petroleum Geologists. He was director of the Rijksopsporing van Delfstoffen until 1917, and has been a Fellow of the Geological Society of London since 1898. Dr. W. J. Jongmans, director of the Geological Bureau of the Netherlands at Heerlen, has added much to the knowledge of Carboniferous stratigraphy. His publications on Carboniferous plants are well known, particularly those dealing with the genus *Calamites*. He is editor of the botanical section of *Fossilium Catalogus*, and was responsible for the volumes in that series dealing with the Equisetales and Lycopodiales. Dr. A. Renier, director of the Geological Survey of Belgium, has

also made numerous contributions to the stratigraphy and palaeontology of the Carboniferous rocks, particularly of Belgium. His published works deal with, among other subjects, fossil plants, coal resources and tectonics. Dr. F. E. Wright of the Geophysical Laboratory, Carnegie Institution, Washington, has investigated the optical properties of minerals, including variations due to changes of temperature. He has also written on the petrological microscope and the surface features of the moon.

COMING to the new Foreign Correspondents, Prof. N. L. Bowen, of Chicago, formerly a member of the staff of the Geophysical Laboratory, Washington, is an authority on the crystallization of magmas and the evolution of igneous rocks. His work is widely known, and has had considerable influence in Great Britain. Prof. R. M. Field, of Princeton University, has carried out researches upon marine sediments, particularly of the West Indies, and has described the geology of the Bahamas. He has also compared the Ordovician succession in Great Britain and America. Baron F. von Huene, professor in the University of Tübingen, is well known for his studies of fossil reptiles, particularly those of the Trias and Lias. He has described forms from Central Europe, South Africa, North and South America, India, and Great Britain. His larger works include monographs on the dinosaurs and ichthyosaurs. Prof. H. Stille, of Berlin, is the author of numerous papers on the geology of Westphalia, Hanover and other parts of Germany, many of them dealing with the Cretaceous system. He has also made a special study of tectonic geology, both in its broader aspects and in relation to particular areas, such as the western Mediterranean.

The Royal Veterinary College and Hospital

THEIR MAJESTIES THE KING AND QUEEN opened on November 9 the new buildings of the Royal Veterinary College, Great College Street, Camden Town, London, N.W.1. A brochure issued to commemorate this event gives a brief history of the College, and an account of its reconstruction, with a description of the new buildings and of the work that will be carried on in them. The brochure is sumptuously produced, and is illustrated with a portrait of Charles Vial de St. Bel, the first principal (1791-93), as frontispiece, three views of the old College buildings, and a plan of the reconstructed College with views of some of its chief features. The old College has been demolished, and the new College block is rectangular in shape, with projecting wings facing Great College Street, the various departments being grouped around two internal courts separated by a central assembly hall. The Beaumont Hospital for Sick Animals and the Canine Hospital are situated to the west, and the Pathological Museum and Pathological Research Institute to the east, of the main block. Behind the Canine block are a reception stable, harness room, garage and workshop. Along the north-east boundary is the Ride in which horses are tested for soundness, horse-boxes, stores and

quarters for attendants. The post-mortem building with cold store, preparation room and laboratories adjoins the Ride. Future extensions planned when funds permit are the Large Animals' Hospital and a field station.

Society of Glass Technology: Twenty-first Anniversary

THE Society of Glass Technology began a two days anniversary meeting on November 9 to celebrate its Coming of Age. The proceedings opened with a luncheon that was attended by the vice-chancellor of the University of Sheffield and Mrs. Pickard-Cambridge, Mrs. F. Wood, Lord Cozens-Hardy, Mr. Geoffrey Pilkington, Mr. W. L. Chance and many other prominent glass manufacturers. In addition, the Society had as its guests four foreign delegates from the Continent, namely, Prof. A. J. de Artigas (Spain), Prof. G. Keppeler (Germany), Dr. B. Long (France), and Dr. H. Maurach (Germany). Of the eighteen original members who still retain their connexion with the Society, thirteen attended. The toast of the Society was proposed by Dr. A. W. Pickard-Cambridge, who spoke of the good effect of such scientific societies internationally and said he looked forward to a time when the University could do more towards developing the artistic side. He concluded by thanking the Society for its generosity in promising to contribute £2,500 towards the Elmfield Fund. The toast was supported by Prof. Keppeler (representing the Deutsche Glastechnische Gesellschaft) and Mr. S. B. Bagley, president of the Glass Manufacturers Federation.

In the evening the presidential address to the Society was given by Prof. W. E. S. Turner, who reviewed the progress in the glass industry during the past twenty-one years. He showed how the development of machine methods, for which we have largely to thank America, has resulted everywhere in the displacement of skilled labour, so that the craftsman has been fighting a losing battle. On the following day a number of technical papers were read. The morning session was opened by the reading of congratulatory messages from members and friends from Germany, Belgium, Denmark, Italy, United States, Canada, and Africa, after which the status of honorary fellow of the Society was conferred upon Dr. H. Maurach of the Deutsche Glastechnische Gesellschaft (Germany) and Dr. Ross C. Purdy of the American Ceramic Society. Dr. Maurach, who with Prof. G. Keppeler represented the German Society, then presented a congratulatory address, after he and a number of ordinary fellows had signed the roll. The address was contained in a magnificently engraved cylinder of glass mounted in silver at the ends, the work of Prof. von Eiff of Stuttgart, and was enclosed in a casket.

New Buildings for Glass Research at Sheffield

ON Tuesday, November 9, a ceremony having an element of novelty took place in connexion with the new buildings at present being erected for the Department of Glass Technology of the University of Sheffield. This was the laying of a foundation

block made of glass, weighing approximately four hundredweight. Mr. Geoffrey Pilkington, of Messrs. Pilkington Bros. Ltd., who cast the block, performed the ceremony in the presence of a distinguished gathering of civic and university authorities and prominent glass manufacturers. He said that he thought he must be the first to lay such a block, and referred to the considerable technical difficulties involved in its manufacture. Immediately previous to the laying of the block, Prof. W. F. S. Turner placed a glass casket containing appropriate records in a cavity in a wall of the building. He said, however, that as the Glass Research Delegacy was quite sure that the list of donors to the Building Fund enclosed was not yet complete, it was not proposed to seal either the casket or the cavity as yet. The pro-chancellor of the University, Lieut.-Colonel Sir Henry Stephenson, sketched the development of the Department from its birth in 1916, and Mr. Bagley, chairman of the Glass Delegacy, announced that of the sum required for the operations, only a further £7,000 now remains to be raised.

FOLLOWING the laying of the foundation 'stone' for the new buildings, the Wood Memorial Library was declared open by Mr. Bagley who, after a prayer of dedication from the Bishop of Sheffield, spoke in moving terms of the work of the late Mr. Frank Wood for the Department of Glass Technology, through the Glass Research Delegacy, of which he was chairman from 1923 until his death in 1934. A beautiful memorial window in stained glass executed by Messrs. James Powell and Sons to the design of Mr. J. Hogan, was then unveiled by Mr. Haslam Wood, son of Mr. Frank Wood. A portrait of Mr. Wood in the centre is supported on the left by scenes illustrating glass manufacture and on the right by others showing research and control. Above are the shields of the Universities of Leeds, London and Sheffield, with a glass furnace below them.

Sir Aurel Stein in Southern Persia

SIR AUREL STEIN described his latest and final journey of archaeological reconnaissance in southern Persia before the Royal Asiatic Society and the Royal Central Asian Society on November 11. In recording his farewell to Iran, Sir Aurel mentioned that in five years he had covered close on five thousand miles on camel, horse and foot—a considerable achievement for any explorer, in view of the difficulties of climate, country and the dangers of tribal interference, but for a veteran past his eightieth year a feat of remarkable endurance. This last expedition, taking up its work where the expedition of exploration in Fars had come to an end in 1934, started from Shiraz in November 1935 and lasted until the autumn of 1936. Its itinerary included the plateau of Ardakhan, the Bakhtiari Mountains, Susa, the Saimarsh River, to which four months was devoted, the little explored Pish-i-koh portion of Luristan, Kermanshah, the high mountain valleys of Persian Kurdistan, where an attempt to reach the border was unsuccessful, and the province of Urumiyeh,

where in the country between Zagros and the salt Lake Urumiyeh, prehistoric remains in the form of mounds, both great and small, far exceeded in numbers any encountered in previous stages of the journey. Here burials in abundance belonging to the second millennium B.C. were found; but difficulties of labour, of which the supply was permanently depleted during the Great War, prevented any extensive investigation. The expedition came to an end at an interesting point, when the reconnaissance was being carried out in the valleys leading down from Kermanshah to the Mesopotamian plains. Orders from Teheran, due to the possibility of difficulties with the tribes, and the incipient illness of the leader, prevented the completion of the programme as planned. Sir Aurel, however, has no ground for dissatisfaction in what had been accomplished. A notable tale of archaeological discoveries of every period from prehistoric to early Mohammedan has been added to his laurels.

Archæological Exploration in Arabia

MR. H. ST. JOHN PHILBY opened up an attractive vista for archæological exploration in an account of his recent journey through Arabia before the Royal Geographical Society on November 15, when he suggested that the Sheban country might be the original homeland of the Phenicians whose place of origin has not yet been determined. In the summer and autumn of last year Mr. Philby traversed Arabia from north to south, from the Mediterranean to the Indian Ocean, a journey of which there is no previous record, although he himself considers that it may have been a route followed at times in the days of the old spice trade. To the archæologist, the most interesting part of Mr. Philby's lecture dealt with his visit to the ancient Himyaritic capital of Shabwa, where, however, he found no evidence to support Pliny's statement, if the identification of that writer's Sabota with Shabwa be accepted, that it had contained sixty temples. The remains of one outstanding temple of supreme magnificence was found, with two ruin heaps within the walls, which one day may be found to contain temples. At the same time there is a possibility, in Mr. Philby's view, that Pliny may have been referring to the whole district of the 'two Shebas', which might well have possessed sixty temples in the days of its prosperity. In the heart of the desert two necropolises were discovered, forty miles away from the nearest wells to-day. Here there were thousands of circular tombs built up of untrimmed slabs of local limestone. The largest tomb was ten feet high and twenty-five feet in diameter. All the tombs had been rifled of their contents and in no instance was evidence of human burial discovered. Judging from the inscriptions, these tombs date from Himyaritic times or earlier. Similarities with cemeteries at Bahrain and in the central Arabian provinces point to Phenician affinities; while certain signs among the inscriptions and rock engravings seem to stand half-way between pictographs and letters, recalling the reputed relation of the Phenicians with the origins of the alphabet.

Problems of Soil Erosion

FOR his Friday evening discourse at the Royal Institution, on November 12, Sir Daniel Hall took as his subject "Soil Erosion: the Growth of the Desert in Africa and Elsewhere". Soil, far from being stable, is easily set in motion by wind or rain if the cover of vegetation and the binding supplied by its roots and humus are unduly disturbed. Deforestation about the headwaters of the streams, followed by grazing by goats which prevent natural regeneration, has brought about the denudation of the hillsides in Levantine countries, has turned the river valleys into malarious swamps and choked the harbours at their mouths. Of recent years the duststorms that have swept across the United States represent the removal of the fertile soil from farming land west of the Mississippi, in many cases to such an extent as to cause the abandonment of the farms. It is not so much agriculture that is to blame, as the continuation of a wasteful system of farming and the breaking up of the sod on soils only fit for regulated grazing. Such wind destruction extends into Canada and has become serious in parts of Saskatchewan and Alberta.

IN Africa the problems of erosion by washing are becoming insistent. The native forms of agriculture are wasteful and depend upon moving on to fresh land every few years. With the growth of population that has followed the Pax Britannica, land is becoming insufficient for shifting cultivation, giving rise to land hunger and political unrest. Still more destructive is the custom, among the Bantu tribes in particular, of maintaining excessive numbers of cattle, sheep and goats, which are not used for food. Live-stock has increased far beyond the capacity of the grazing grounds, and, with overstocking, erosion sets in. So far from affording opportunities for colonization, much of the best land in East Africa is rapidly wasting and leaving its inhabitants under a growing threat of famine. Sir Daniel exhibited photographs of the remedial measures that are being adopted, but it will be necessary to interfere somewhat drastically with tribal customs before the natives can be taught to practise a system of agriculture that will maintain the fertility of the land and allow of continuous production. Considerable expenditure is probably required in order to implement British trusteeship for the inhabitants of Africa who are now destroying their means of existence.

Kashmir Earthquake of November 14

AN earthquake of some strength occurred on the afternoon of November 14 in north-western India, especially in the province of Kashmir. That it attained semi-destructive intensity (degree I of the Milne scale) is clear from the slight damage that occurred at Srinagar, Abbottabad, and other places. The earthquake is of interest chiefly from its association with more violent shocks in the same province. Within little more than a century, two earthquakes of Milne's highest order of intensity (III) visited Kashmir, one in 1828, the other in 1885. Another, of intensity II, occurred on December 4, 1885, in the district around Chamba (about 150 miles south-

east of Srinagar), and two others, of about the same intensity as the recent shock, in that near Srinagar on August 28, 1916, and January 20, 1931. Of these earthquakes, by far the most interesting is that of May 30, 1885, studied by Mr. E. J. Jones, of the Geological Survey of India, whose brief report is published in the *Records of the Survey* (18, 221-227). In the small meizoseismal area of this earthquake, containing about 47 square miles, the destruction of villages was complete and about 3,000 persons were killed. The next isoseismal includes Srinagar near its east end, and within it large portions of the towns and villages were thrown down. Abbottabad lies a short distance to the west of this isoseismal. Thus, it would seem that the origin of the recent shock may have been connected somewhat closely with that of its much stronger predecessor in 1885.

Benefaction to Edinburgh Astronomical Association

THE Edinburgh Astronomical Association will shortly be in possession of about £25,000 under the will of the late Mr. J. H. Lorimer, the well-known artist. Mr. Lorimer had been a member of the Association since 1924, when the first general meeting of the Association was called. He served for a time as a member of council some years ago and later was elected vice-president. He was much interested in astronomy and in the Association, and regularly attended the Association's meetings. The Association has always had plans for development, but has been hampered in the past by the small income available. Now that this is to be much increased, the council is considering which in particular of the many possible schemes will best use the money for the benefit of astronomy. As yet the only decision made is to extend the Association's library. The objects behind further decisions are likely to be: to advance the science of astronomy and promote astronomical research, to circulate information on astronomical matters by publication and generally to encourage astronomical study and to increase popular interest in the science. Negotiations are being conducted with the view of using the Edinburgh City Observatory for research and education. This Observatory has not been in use since the death of the City Astronomer, Mr. J. McD. Field, in April of this year.

Physical Fitness of University Students

THE University authorities at Leeds have introduced a scheme of medical examination and advice which should be of considerable assistance to students in the maintenance of their health while they are at the University. The scheme is on an entirely voluntary basis, but there is reason to think that it will be used extensively. A certain number of medical practitioners, resident in different parts of Leeds, are co-operating with the University for this purpose. A student who registers under the scheme (paying a nominal fee of half a crown) is entitled to go to one of these doctors, at his own choice, for examination and advice. The scheme is not intended to provide medical treatment for students, but rather to help them to avoid the necessity for treatment. In the past, members of the staff have always been ready

to advise and help students when any questions have arisen in regard to their health; the new scheme, however, by providing a simple form of machinery, will encourage students, whatever their present condition of health, to satisfy themselves of their physical fitness or be advised in good time of the measures they should take to become fit. Consideration is also being given by the authorities to the possibility of extending the facilities for physical training at the University. The students are naturally watching with keen interest these developments, which are taking place in consultation with the Union Committee.

Agricultural Marketing Policy

UNDER this head, Mr. A. N. Duckham, research officer to the Bacon Development Board, made a weighty contribution to the discussion on "State Intervention in Agriculture", which was held in Section M at the British Association meeting in Nottingham. In his view, recent marketing legislation is the offspring of the researches and inventions associated with the names of Liebig, Mendel, Faraday, Pasteur and others, and of the necessity for rectifying the imbalance between agriculture and manufacturing industries. The protective measures adopted by the marketing boards have helped to save British agriculture from chaos by reducing, through price stabilization, the speculative nature and insecurity of 40-50 per cent of home production, and by prompting improvements in agricultural business methods. Other beneficent activities of the boards have been the laying down of minimum quality standards, the standardizing of trade practices, and the institution of good market-intelligence services. Equally important have been the provisions made for controlling competition, for example, by limiting the number of sugar-beet factories, creameries, bacon factories, potato merchants and cattle markets. The savings effected by cutting out surplus capacity and operating the remainder at full load should, it is stated, reduce the price spread between farmer and consumer; and farmers should benefit by the practice of collective bargaining, which is one of the main objects of the Marketing Acts. A noteworthy feature of current policy is the statutory attempt to influence demand by 'consumption steering', that is, by means of differential prices and subsidies to consumers, by education, habit-changing and direct publicity. So far very little has been done in this direction, but, in the author's view, the success of current marketing policy will be largely governed by steering consumption more vigorously towards the produce of British soil. Planning and State intervention have come to stay, and their prospective effect will be to ensure stability of quality, supply and price.

Development of the Glasshouse Industry

A SERIES of papers delivered before Section M (Agriculture) of the British Association at Nottingham on September 6 dealt with the history and present-day practice of the growth of crops under glass. Mr. H. V. Taylor first indicated trends in the technique of plant forcing, from the early use of the cloche,

through the employment of frames and greenhouses, to the modern Dutch lights and 'aeroplane' tomato houses. Dr. W. F. Bewley spoke upon "Science in Relation to the Glasshouse Industry". He showed how the increase in intensity of crop forcing, and the growth of produce out of its normal season, brings new problems of disease and of nutrition. Many examples of how these troubles have been overcome by the Cheshunt Research Station were given. Some of the investigations, as the work of Lloyd on control of the tomato moth caterpillar, and that of Speyer upon the control of white fly, are now classical, and the newer research maintains the high standard. A most welcome link with practice was provided by Mr. F. A. Secrett's paper on "The Production of Early Vegetables and Salads under Glass". The need for vegetables quickly grown on good soil, as a contribution to national health, was stressed. A suitable light soil, adequately manured, and a site with security of tenure and adequate water supply, are the first essentials. Heavy capital costs and labour charges are incurred, but Mr. Secrett's practical demonstration of commercial success is even more eloquent than his illuminating paper.

Fire-Immune Cable

A FACTORY, opened by Lord Ridley on October 12, for making fire-resisting cable called 'Pyrotanax', marks a new development which promises to be of far-reaching importance to the electrical industry. The insulating cover utilizes a new insulating material, magnesium oxide, the heat-resisting and other physical properties of which have been proved in connexion with boiling-plate elements, which are made of resistance wire embedded in the oxide. 'Pyrotanax' cable has a copper conductor, magnesia insulation, and copper sheath. The new technique enables continuous runs of this cable up to 300 yards to be produced. A piece of cable in series with a burning lamp can be hammered to the thickness of a sixpence without affecting the light. It is therefore mechanically robust. For all practical purposes the cable is immune from fire and would not contribute anything to a possible conflagration. Notable use has been made of 'Pyrotanax' cable in France. The Louvre, the *Normandie*, the Galeries Lafayette and the French railways use it. In Great Britain it has been adopted for the new lighting equipment of the Tate Gallery and for several industrial installations. The 'Pyrotanax' factory is practically 'all-electric' throughout, electric furnaces being used for all the annealing stages and for the dehydration of the magnesium oxide insulation. The rating of these furnaces is 250 kilowatts, and their temperature is controlled by a Cambridge thermostatic instrument. The factory is situated at Hedgely Road, Hebburn-on-Tyne. A full illustrated account appeared in the *Electrical Times* of October 21.

Electrical Accidents and their Causes

IN a pamphlet issued by the Home Office (London: H.M. Stationery Office, 1937, 6d.) and written by H. W. Swann, H.M. Inspector of Factories, a report of electrical accidents for the year 1936 is given. The

report deals not only with accidents that have actually occurred but also with the large-scale methods for preventing danger and damage which have been discussed with the electrical industry. The total number of fatal accidents reported, 112, is satisfactorily small, and comparing it with previous years it indicates no marked variation from a steady mean. The variations in the numbers reflect the periods of industrial activity and depression. It is noted that there has been an increase in the number of accidents to male persons less than twenty-one years of age during the last five years. A feature of the electrical accidents is the large percentage (55 per cent) in which the injury was due to burns alone. Joining of metal by arc welding is rapidly becoming popular. Practically all the welding accidents (57) are cases of conjunctivitis (eye-flash) and none of them was fatal. Stress is very properly laid on the provision of suitable goggles for workers liable to be exposed to radiations from the arcs.

Vehicle Tests on Motor Roads

HIGHWAY engineers are interested in tests recently made by the German road authorities on the comparative efficiencies of motor roads and ordinary roads. An abstract of a paper on the subject is given in *Roads and Road Construction* of August. The results of the driving efficiencies obtained in two approximately parallel roads joining Bruchsal to Bad Nauheim, a distance of about 91 miles, are given. One of these was an *autobahn* road and the other a State road specially constructed for long-distance journeys which had been greatly improved during the last four years. The latter road was comparable in layout and surface condition with a Class I road in Great Britain. The tests were made with an ordinary high-powered car. On the State road, the journey took 2½ hours at an average speed of 44 miles per hour. On the motor road it took 1½ hours at an average speed of 74 m.p.h.; on the State road the average speed was only 56 per cent of the maximum speed of the car; on the motor road it was 92 per cent. On a second journey undertaken on the motor road at the same average speed as that attained on the ordinary road, the petrol consumption dropped from 5.5 to 3.1 gallons. Considering that on the ordinary road 351 cars were met and 158 overtaken, exclusive of bicycles and pedestrians, the feeling of safety is much greater on the motor road as there are no oncoming cars to avoid. The tests were made with a 3.21 Mercedes car. It is concluded that on the motor road you always arrive quicker at your destination than is possible on the ordinary road and consume less fuel. On this road also the safety is greater and the stress to which the driver and car are subjected is much less. Further experimental results are to be carried out on speed trials with other cars.

Kelvin and the Atomic Theory

IN his tribute to Lord Rutherford in *NATURE* of October 6, Prof. A. S. Eve states that Lord Kelvin died in unbelief of Rutherford's atomic theory. Mr. C. Turnbull, 21 Percy Park, Tynemouth, North-

umberland, has pointed out that this is incorrect. In his presidential address to the Physical Society (January 1936), Lord Rayleigh (p. 221) states that Kelvin argued emphatically with Rutherford and himself against the atomic origin of the energy. Rayleigh asked him to make a bet of five shillings that within three (or six) months he would admit that Rutherford was right. Within the allotted period Kelvin came round, and at the British Association he made a public pronouncement in favour of the internal origin of the energy of radium. He also produced the five shillings in settlement of the bet.

Announcements

THE Right Hon. Lord Riverdale has been appointed chairman of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research in succession to the late the Right Hon. Lord Rutherford of Nelson. Sir William H. Bragg has been appointed a member of the Advisory Council.

THE following have been elected as officers of the Cambridge Philosophical Society for 1937-38: *President*: Sir F. Gowland Hopkins. *Vice-Presidents*: Dr. C. G. Darwin, Mr. F. P. White, Prof. J. Gray. *Treasurer*: Dr. J. D. Cockcroft. *Secretaries*: Mr. A. H. Wilson, Dr. O. M. B. Bulman, Mr. J. A. Ratcliffe. *New Members of the Council*: Dr. N. Feather, Dr. C. F. A. Pantin, Mr. E. N. Willmer.

At the anniversary meeting of the Mineralogical Society held on November 4, the following officers were elected: *President*: Dr. L. J. Spencer; *Vice-Presidents*: Prof. P. G. H. Boswell and Prof. C. E. Tilley; *Treasurer*: Mr. F. N. Ashcroft; *General Secretary*: Lieut.-Colonel W. Campbell Smith; *Foreign Secretary*: Prof. A. Hutchinson; *Editor of the Journal*, Dr. L. J. Spencer.

At 6.57 p.m. (G.M.T.) on November 16, Flying Officer Clouston and Mrs. Kirby-Green arrived at Capetown from London, having flown the distance in 45 hours 2 minutes. The route taken was through Cairo, Khartoum, Broken Hill and Johannesburg. They have thus beaten the record set up by Miss Amy Johnson by 33 hours 23 minutes.

FOR the first time in history, a medical man in the person of Dr. Roussy, dean of the Paris medical faculty and well known for his researches on the nervous system, endocrinology and cancer, has been elected rector of the University of Paris.

THE Francis B. Garvan Gold Medal established by the American Chemical Society to honour outstanding women chemists has been awarded to Dr. Emma R. Carr, head of the Mount Holyoke Department of Chemistry. Dr. E. Bright Wilson, jun., assistant professor at Harvard University, has received the one thousand dollar award from the Society for his experimental work in physical chemistry.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 897.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Kinetics of Polymerization

A RECENT paper¹ on the kinetics of gaseous polymerization reactions appears to lead to some doubts concerning the interpretation of experiments in the liquid phase. It is now found that gaseous styrene is stable at temperatures up to 400° C., a result which seems inconsistent with the published data on the rate of polymerization of liquid styrene. The results of Schulz and Husemann² can be expressed by means of a unimolecular constant, given by

$$k_1 = 1.1 \times 10^7 e^{-21,000/RT} \text{ sec.}^{-1},$$

while Suess, Pilch and Rudorfer³ find a bimolecular constant,

$$k_2 = 2.5 \times 10^6 e^{-21,500/RT} \text{ mol./l./sec.}$$

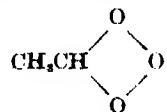
Further, Wassermann⁴ has shown that the rates of a number of diene additions are the same in the gas phase and in solution, so that we can with some confidence employ the expressions above to calculate the rate of the gaseous polymerization.

At sufficiently high temperatures, the reverse process of depolymerization will become sufficiently important to mask the forward reaction. According to Blyth and Hofmann⁵, polystyrene is depolymerized on heating above 300° C., and up to this temperature the above formula should therefore hold. The calculated half-lives for the reaction at 300° C. and atmospheric pressure are 6 sec. and 46 min., and it is clear that there is a very large discrepancy between these figures and the results of Kistiakowsky. It is suggested in explanation that the liquid phase results refer to a catalysed reaction, the catalyst being in all probability a peroxide which may initiate chains by the formation of a complex⁶.

Definite evidence has been obtained that this is the case for vinyl acetate, which Kistiakowsky also found to be stable up to 360° C. in the gas phase. Starkweather and Taylor⁷ found that the polymerization of liquid vinyl acetate at 101° C. could be represented by a first order constant, $k = 5.0 \times 10^{-3} \text{ min.}^{-1}$. Breitenbach and Raff⁸ were unable to obtain consistent results in glass vessels, and Breitenbach⁹ has attributed this difficulty to the presence of traces of moisture which react with the alkali of the glass to give sodium hydroxide. When the ester was dry, Breitenbach found that its rate of polymerization at 98° C. was only one hundredth of that found by Starkweather and Taylor. We have found that pure vinyl acetate does not polymerize measurably at 100° C., and believe the rates measured by the former authors to be due to the presence of peroxides.

Commercial vinyl acetate may contain a small amount of acetaldehyde¹⁰ which in the presence of air

forms a peroxide, probably of the formula



Samples of vinyl acetate capable of polymerizing at 100° C. always gave a peroxide test, and the rate and extent of polymerization were found to be associated with the amount of peroxide present. It is perhaps significant that this substance can be eliminated by distillation with an efficient fractionating column but is by no means completely removed by careful vacuum distillation. It is probable that the role of the sodium hydroxide produced when the ester is moist is to saponify some of the vinyl acetate yielding vinyl alcohol, which is tautomeric with acetaldehyde. We may note further that aldehyde-free vinyl acetate does not polymerize at 100° C. even in the presence of oxygen: samples were shaken with air or oxygen for two weeks but remained stable when afterwards heated to 100° C. Identical results were obtained from supplies of vinyl acetate from two sources.

The study of the initiation of polymerization by aldehydes and oxygen is being continued and fuller details will be published in due course.

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¹ Harkness, Kistiakowsky and Mears, *J. Chem. Phys.*, **5**, 682 (1937).

² Schulz and Husemann, *Z. phys. Chem.*, **36**, B, 194 (1937).

³ Suess, Pilch and Rudorfer, *Z. phys. Chem.*, **170**, A, 361 (1937).

⁴ Wassermann, *Parad. Soc.*, General Discussion, September, 1937.

⁵ Blyth and Hofmann, *Ann.*, **58**, 315 (1845).

⁶ Gee and Rideal, *Trans. Farad. Soc.*, **32**, 666 (1936).

⁷ Starkweather and Taylor, *J. Amer. Chem. Soc.*, **52**, 4708 (1930).

⁸ Breitenbach and Raff, *Ber.*, **69**, 1107 (1936).

⁹ Breitenbach, *Z. Elektrochem.*, **43**, 323 (1937).

¹⁰ Blakie and Crozier, *Ind. Eng. Chem.*, **26**, 1155 (1936).

Phase Transformation in Locusts in the Field

IN 1921 Uvarov¹ enunciated the 'phase theory' to account for the swarming of locusts, a theory which postulated post-embryonic divergences in the pigmentation, structure and behaviour of members of the same species. This theory has since been proved by field observations and by experiment to be correct in a number of locust species, and in breeding experiments the changes were found to be due to the density of population of locusts².

The question which has so far remained unanswered, however, is how the individuals of a population of solitary locusts in the field, less numerous than gregarious locusts, and without the 'gregarious instinct' of the latter, could encounter one another with sufficient frequency to bring about the change of the phase *solitaria* through *congregans* to *gregaria*. My investigations of the behaviour of the solitary phase of *Schistocerca gregaria* Forsk., on the Red Sea coast of the Sudan during last winter, have thrown some light on the mechanism by which this transformation occurs in the field.

For various reasons, the solitary 'hoppers' of the 4th and 5th instars tend to concentrate into patches of dense but uneven vegetation, which is usually unweeded millet cultivation. One of the most

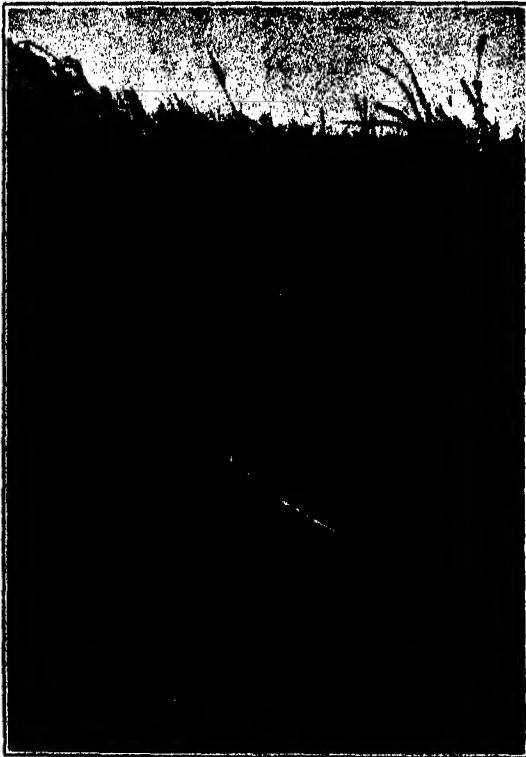


Fig. 1.

A 'BASKING-PLACE' OF SOLITARY LOCUSTS AMONG UNWEEDED MILLET CULTIVATION. A THERMOMETER WITH BULB EXPOSED TO THE SUN (APPEARING AS A WHITE LINE), AND A SMALL SCREEN SHADING ANOTHER THERMOMETER AND AN EDNEY PAPER HYGROMETER (TO THE LEFT OF THE FIRST THERMOMETER), ARE LYING ON THE BARE SAND OF THE 'BASKING-PLACE'.

interesting reasons for this is the existence of a visual attraction to the millet stands (probably perceived as dark objects), which I was able to demonstrate experimentally. Within the 'concentration zones' the absence of wind permits the sun's radiation, in conjunction with vegetation of very uneven height (Fig. 1), to produce a close 'patchwork' of different temperatures, humidities and light intensities. Small patches of bare ground, such as that shown in Fig. 1, constitute the warmest and driest situations available. Solitary hoppers are not as inactive as formerly supposed, and at certain times of day

they form loose basking groups on the bare patches. I was able to demonstrate that the formation of such groups must largely be attributed to the separate reactions of each individual to the temperature stimulus, as presented in the 'patchwork'. Without any gregarious instinct, the solitary hoppers are forced into association, simply because their numbers are large in relation to the number of bare patches available in the vicinity. This crowding of hoppers may have the same effects as breeding in densely populated cages, namely, changes in coloration, morphology and in the inter-reactions of individuals, so that the bare patches may be regarded as the birth-places of gregariousness, for without them the change of phase would probably be impossible, however numerous the locusts became.

It was also found that gregarious hoppers, whose cohesion in bands is maintained by some form of inter-attraction which is perhaps visual, were too active to remain together on the bare patches, so that the bands tended to break up in unweeded cultivation. Such vegetation is, therefore, on one hand indispensable to the production of phase *gregaria*, but on the other hand, fatal to the continued existence of this phase. The survival of the hopper bands and adult swarms of this phase is only made possible by their 'breaking out' of the environment which has engendered them.

Another interesting result, partly of field observations and partly of rough experiments, was that the direct relation between activity and temperature in temperature-adapted hoppers, is reversed in hoppers not adapted to temperature. Over a certain range, temperature-adapted hoppers are, of course, more active at higher than at lower temperatures, but the effect of sudden increase of body temperature is temporarily to depress activity, while sudden temperature decrease temporarily accelerates activity. This principle may have much wider applications.

A detailed account of these investigations will be published elsewhere.

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Bull. Entom. Res., 12, 135-163 (1921).

* Faure, *Bull. Entom. Res.*, 23, 293-403 (1932).

Nomenclature of the Seasons

ONE frequently hears it said that the swallow passes the winter in South Africa, though a moment's reflection shows that it is summer in South Africa when the swallow is there. There appear to be no words for times of year, longer than a calendar month, applying to the whole world. Again, when one is trying to analyse periodic phenomena among organisms in the tropics, one is continually hampered by the lack of words denoting the seasons; for spring, summer, autumn and winter are meaningless near the equator. One may speak of the rainy and dry season or seasons, but the periods are often ill-defined. If one extends the words for the temperate seasons into the tropics, one cannot escape such absurdities as saying that in south-west Ceylon the winter is the hottest season. Such considerations as these have driven me, despite an aversion from all unnecessary complications of nomenclature, to suggest a series of eight new words.

Each of the first four words is applicable (like a calendar month) to the whole world at the same date :

Boredune. March 22-June 21 (approximately) : the time when the sun is in the northern hemisphere and going towards (δύνα) the north (βόρεια).

Borepheuge. June 22-September 21 : the time when the sun is in the northern hemisphere and going away from (φεύγειν) the north.

Notodune. September 22-December 21 : the time when the sun is in the southern hemisphere and going towards the south (νότος).

Notopheuge. December 22-March 21 : the time when the sun is in the southern hemisphere and going away from the south.

These words make possible such succinct statements as the following. The swallow breeds in Europe in the boredune and borepheuge and passes most of the notodune and notopheuge in South Africa. Very few species of birds breed in the southern hemisphere and pass the boredune and borepheuge in a non-breeding condition in the northern hemisphere. The Gouldian finch of Australia exhibits an internal rhythm in reproduction : for it breeds about the notodune in its native haunts, and individuals imported into the northern hemisphere tend to continue to breed in the notodune.

There is also a need for words which apply to the whole of one hemisphere (north or south), that is, words which extend the concepts of spring, summer, autumn and winter right through the tropics to the equator.

Homodune. The season when the sun is in the same hemisphere (north or south) as the place spoken of and going towards the pole of that hemisphere (ὁμός same). This word, applicable everywhere, is the same as spring in temperate latitudes, if one allows the official sense to the word spring. The days are lengthening during the homodune.

Homopheuge. The season when the sun is in the same hemisphere as the place spoken of and going away from the pole of that hemisphere. In temperate latitudes this is the same as summer. The days are shortening during the homopheuge.

Heterodune. The season when the sun is in the opposite hemisphere to the place spoken of and going towards the pole of that hemisphere (ἕτερος other). In temperate latitudes this is the same as autumn. The days are shortening during the heterodune.

Heteropheuge. The season when the sun is in the opposite hemisphere to the place spoken of and going away from the pole of that hemisphere. In temperate latitudes this is the same as winter. The days are lengthening during the heteropheuge.

The following are examples of the use of these four words in sentences which require considerable circumlocution without them. The blackbird starts laying about the beginning of the homodune in Britain and also in New Zealand, where the descendants of imported specimens have established themselves ; in Ceylon it breeds about the beginning of the homodune and again about the end of the homopheuge. In Britain we have no species of bird with a special breeding season starting in the heterodune, but there are heterodune-breeders among tropical and southern hemisphere birds. Almost throughout their range most species of fruit-bats copulate in the heterodune, and there is thus a difference of about six months in their breeding seasons on the two sides of the equator. In the tropics the rainy season or seasons usually fall in the homodune and homopheuge : often there is a rainy season in each, separated by a short drier period.

I am greatly indebted to my friend, Mr. E. B. Ford, for translating my concepts into easily pronounced and intelligible words based on Greek. It may be remarked that the first 'o' of notodune and notopheuge is short.

It is hoped that students of migration and of seasonal phenomena in the tropics may consider the possibility of these eight new words being useful. The new knowledge of the relationship between light and reproduction may be thought to lend weight to a system of the seasons based on the apparent movement of the sun and therefore on the change in length of day.

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Non-Specificity of the Trio Follicles in the Merino

I HAVE the privilege of collating the valuable notes of the late Prof. J. E. Duerden, having been his colleague and friend for the past two years. Prof. Duerden's recent work on the embryology of the fleece has important implications of both a fundamental and an applied character, and it is felt that the following advance note, indicating some of the results he obtained, approaches in some measure the type of communication which Prof. Duerden himself contemplated writing at the time of his death.

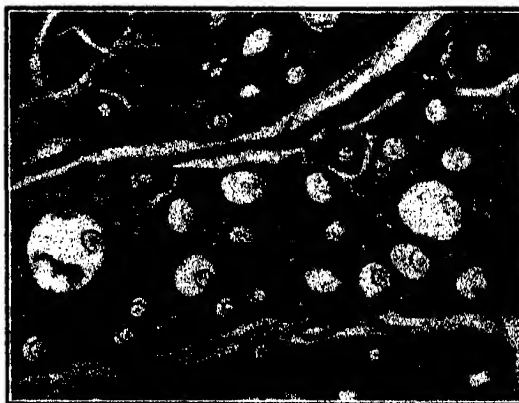


Fig. 1.

Magnification $\times 120$.

Prof. Duerden's investigations were chiefly in the form of a comparative study of follicular arrangement in both foetal and post-natal stages of the Ovidae, and also of many other mammals. He established the fact of the common and fundamental nature of the arrangement of the early follicles in trios, noted in some mammals by other workers, and also observed that these follicles produce coarse birth-coat fibres ; he states in this connexion that "Production of the woolled fleece is by the loss of the coarse fibres *grown by the trio follicles*" and, I would add, of course, by the addition of finer fibres chiefly grown by later developing follicles.

With reference to this aspect of the developing fleece, Prof. Duerden has established the important point that a follicle which in the lamb produces a coarse, kempy birth-coat fibre may later produce a fine

non-medullated wool fibre. He has shown that this actually occurs in the South African Cape Merino lamb, and the photomicrograph (Fig. 1) reproduced here (magnification $\times 120$) constitutes evidence supporting his view. This is a photograph of a horizontal section of skin from a four months' old Cape Merino lamb: so many new follicles and fibres have become differentiated that the early trio arrangement is somewhat obscured. Large birth-coat follicles, however, are clearly shown which have already shed their coarse birth-coat fibres, and in these same large follicles can be seen recently keratinized fine non-medullated wool fibres. Here again a note of Prof. Duerden's may be aptly quoted: "Changes in the arrangement and character of the fibres occur during the life of the sheep, especially as between the birth-coat and the adult fleece. The foetal distinction in size between the trio and the later follicles may be accentuated, as in the Somali and wild sheep, or may be reduced, as in the Suffolk and Leicester, and the fleece become more uniform; the coarse trio fibres may be shed and replaced by fine fibres (that is, in the same follicles), as in the fine-woolled Merino."

Prof. Duerden's work also suggests the importance of the follicle bundle as a genetic morphological unit, and how its nature may influence such fleece characters as type of staple formation, degree of sample uniformity in fibre diameter, and fleece density.

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Androgenic Endocrine Activity in the Female Mammal

PARKES¹ recently made the very important statement that ovarian extracts may show androgenic activity when tested on the comb of the capon. Since there was no androgenic activity in purified ovarian hormones, Parkes reasonably concluded that the androgenic activity of the extracts was probably due to the presence of substances of the androsterone-testosterone group.

Many observations demonstrate that androgenic activity can be induced experimentally in the female guinea pig by certain agents which act on the ovary without changing its microscopical aspect. The clitoris of the guinea pig offers a very convenient test for androgens; more than twenty years ago² I discovered its transformation into a penis-like organ under the influence of a testicular graft (in one of the experimental animals which Prof. Steinach generously put at my disposal). Sand³ independently found a similar phenomenon in the rat. Since then, the transformation of the clitoris of the guinea pig into a penis-like organ has been seen by other investigators working with testicular grafts or testicular hormones.

Now a penis-like organ can also occasionally be found in untreated female guinea pigs which are otherwise normal⁴. A similar condition can be produced experimentally by exposing the ovaries to X-rays or by injecting gonadotropic extracts (Steinach and Kun⁵). A typical penis-like organ may grow in less than three months after 'partial castration', that is, when the quantity of ovary is diminished to a minimum by resection (in six out of twenty animals operated upon when adult⁶).

Steinach and Kun emphasized the extensive luteinization of the ovary seen in their successful experiments, but the ovaries in our guinea pigs with a spontaneous penis-like organ, and likewise the androgenic ovarian fragments, showed no excessive luteinization. Similar results were obtained in a new series of twelve guinea pigs, out of which again six revealed the penis-like organ. These animals were operated on when 4-28 days old, one ovary being removed and the other reduced to a minute fragment. The transformation of the clitoris became manifest only about eleven to twelve months later. The ovarian fragments were examined 32-33 months after operation, and showed cystic follicles and sometimes luteal cysts, but only twice in a total of twelve positive cases was I able to state with certainty that hypertrophy had taken place of those tubular structures of the ovarian medulla which may be considered as a masculine rudiment. One of the most interesting features of our experiments is the fact that the experimentally induced androgenic activity does not depend upon microscopical ovarian changes suggestive of gonadal intersexuality. This indeed does not exclude the possibility suggested by Parkes of androgenic male hormones being produced in the ovary.

An ovarian graft in a castrated male guinea pig may exceptionally maintain the seminal vesicles and the prostate in a normal condition⁷. This was recently shown also for castrated mice with ovarian grafts⁸. In our case, in which the graft was not examined until 34 months after transplantation, there was an enormous development of epithelial tissue due to proliferation of the medullary ovarian tubules; but in view of our microscopical results with ovarian fragments, the condition of this graft may be considered as exceptional and not necessarily related to the androgenic activity.

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National Institute of Radium (Cancer),
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Sept. 2.

¹ Parkes, NATURE, 139, 965 (1937).

² Lipschütz, Anz. Akad. Wissensch. Wien, No. 27 (1916); Arch. Entw.-Mech., 44, 196 (1918).

³ Sand, Pflügers Arch., 178, 1 (1918).

⁴ Lipschütz, Brit. J. Exp. Biol., 4, 227 (1927).

⁵ Steinach und Kun, Pflügers Arch., 227, 265 (1931).

⁶ Lipschütz, C.R. Soc. Biol. (Paris), 112, 1272 (1933).

⁷ Lipschütz, Virchows Arch., 235, 35 (1932).

⁸ De Jongh und Korteweg, Acta Brevia Neerland., 5, 126 (1935). Hill and Gardner, Anat. Rec., 64, Supp. 21 (1936). Hill, Endocrinology, 21, 495, 633 (1937).

Restropic Effects of Anterior Pituitary Extracts

SEVERAL authors have attributed endocrine functions to the reticulo-endothelial system (R.E.S.) and have employed, for various purposes, extracts prepared from its centres. But no link between endocrine glands and the R.E.S. has as yet been demonstrated. Recently, however, we have obtained evidence of pituitary control of the reticulo-endothelial system. The experiments were carried out on rabbits. A modification¹ of the Congo-Red method² was used in assessing the activity of the R.E.S. The rate at which the dye is eliminated from the circulation reflects the functional condition of the system, and the method which measures this rate thus yields an index of the activity of the R.E.S.

First the normal rate was determined in each animal. Injections of various pituitary extracts were then administered and the rate of elimination was again determined at regular intervals. Certain aqueous extracts produced a rapid rise in the activity of the system. The rise was noticeable 24 hours after the first injection but did not attain its maximum until some days later. Cessation of the injections resulted in a return to the normal level. Thus one rabbit showed an initial index (per cent of dye eliminated within one hour) of 45.7. After three daily injections of 1 mgm. each the index rose to 76.9; 10 days after the last injection the index had fallen again to 48.5. The treatment was not followed by any signs of damage to the R.E.S. These effects were obtained with extracts that did not contain the growth factor and were free of, or contained traces only of, gonadotropic and thyrotropic hormone. The active substance is highly soluble in water and can be extracted even with distilled water. A highly potent extract was prepared from fresh anterior lobes (cattle pituitaries) in a Soxhlet worked under reduced pressure. Water was used as extractive and an alkaline reaction was maintained by repeated addition, to the gland material, of weak ammonia. The active substance is insoluble in acid 70 per cent alcohol but soluble in alcohol containing 3 per cent ammonia. It is precipitated by phosphotungstic acid, rapidly destroyed by boiling and unstable in solutions kept at room temperature.

Purified gonadotropic hormones prepared from the anterior lobe of cattle pituitaries, from human placenta or pregnancy urine, and from the blood of a menopausal subject failed to affect the R.E.S.-index significantly or even uniformly.

Strongly thyrotropic extracts, prepared from anterior lobe and containing a proportion of gonadotropic hormones, significantly and rapidly lowered the index. For example, 61 per cent of the dye was eliminated in an untreated rabbit within one hour after its injection. After three daily injections, the rate had fallen to 26 per cent. But the fall in the activity of the system persists for a few days only. A return to the norm takes place even when the injections are continued.

It thus seems likely that the anterior pituitary is involved in the regulation of the R.E.S. Presumably it influences, therefore, some aspects of immunity.

The influence of the gland may be complex since it yields at least two active derivatives. One type of extract increases the activity of the R.E.S.; in accordance with current terminology, we propose to refer to the active substance as the 'positively restropic factor'. Another type of extract, characterized by its thyrotropic activity, is negatively restropic; that is, it lowers the activity of the R.E.S. The positively restropic factor is manifestly not identical with the growth factor or the gonadotropic hormones. But it may be identical with one of the other anterior lobe hormones for which separate existence has been claimed.

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Nov. 9.

¹ Adler, H., and Reimann, F., *Z. Exp. Med.*, 47, 617 (1925).
² Stern, K., and Wilhelm, R., *Z. Exp. Med.*, 97, 354 (1935).

Interpretations of Atomic Constitution

THE correspondence columns of NATURE are usually devoted to contributions from specialists, and for a layman to enter into them may be regarded as an intrusion. There must be, however, many readers who, unable to be advanced workers in any particular branch of science, try to follow current thought, especially in physics. They form the bulk of those who read and enjoy the more popular expositions of science by fellows of the Royal Society and others actually engaged in scientific work, and many look forward to the arrival of NATURE.

Could one of such interpreters give an explanation of the difficulties some of us find in the present contemporary picture of atomic structures? We know it is only a rough picture. A billiard ball model of the atom is, we know, impossible. Recent bombardment experiments bear out, however, the general rough scheme of things. Heisenberg, with his indeterminacy, certainly introduces anxieties. On the other hand, in the answers do not allow a shift to wave mechanics: we would look upon that as an unfriendly 'action'. Could NATURE, however, get some explanation given us of such difficulties as the following:

(1) No doubt in popular works it is difficult to express things correctly, but I notice reference frequently to the charge on the electron or proton. Surely these two elements are the charge and nothing else, even if they do differ in mass by a factor of 2000, or is the ephemeral positron now looked upon as the charge on the proton?

If, to account for isotopes, we must introduce neutrons, no difficulties present themselves if a neutron can be looked upon as a proton married happily to an electron in domestic bliss with no charge. Just mass. But we are told (see Prof. Andrade's article in NATURE of September 8, 1934) that we must not look upon the neutron as having within itself an electron. The consequence seems to lead to philosophical difficulties; for now the neutron is just a lump of matter, and the theory that matter is electrically built up, fails. Is this point conceded, or if not, why not?

(2) The nucleus in heavy atoms presents the most serious difficulties. Here, we are told for each atom, live concentrated together a group of protons, corresponding in number to the electrons in their orbits, plus some neutrons to account for isotopes and other things. Yet the protons, being positively charged, must dislike proximity with the same vehemence as the electron. How is it assumed that they can remain packed together? Prof. Andrade, in his attractive book "The Atom", page 71, envisages a scale model with the nucleus the size of a plum, with electrons occupying orbits two thousand feet across. If the nucleus is made up of protons, as bombardment apparently proves it to be, and if each proton has, or is, a positive charge, then such a picture is mathematically an absurdity. What is the force holding them together?

If I am told that under certain conditions two similarly charged protons can be made to unite to form a super proton of mass 2 and charge 2, or even more, but always in units of protons plus a neutron or two—rather like similarly charged blobs of mercury, sitting on a glass plate, disliking proximity, but by force made to amalgamate; if I am told that this super proton, now called a nucleus, is held together by a new sort of atomic 'surface tension'

but can be broken up by bombardment; if I am told that in such breaking up it may shed a proton or two which will change the chemical properties of the atom and that energy will be released; that is a story which anyhow accounts for the facts, and for Prof. Andrade's 'plum', although not really explaining them, but the trouble is no one mentions the difficulty of protons just living together, maintaining their individuality.

The above idea may be fantastic, but let us have some story; at present we have none. There may be answers, easy ones, to those difficulties, which are asked in all sincerity of those who have worked so wonderfully in this new entrancing wonderland of physics, and for whom no one has greater admiration than myself.

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At one time it was the fashion to ask "What is electricity?" and to taunt, or condole with, the man of science, because, said the questioner, he had no answer to offer. The question I always considered unreasonable, since we must take some fundamental entity, which we cannot explain in terms of other substances, as the basis of our theories, and electricity is an aspect of our fundamentals. It is not a kind of liquid, or a kind of gas, but something quite different from both. There should never be any question of calling electricity a fluid, and then expecting to deduce its complete behaviour from the known property of fluids. What we have rightly done is, rather, to find out by experiment what its actual properties are, and what general laws will cover them. It then proves that for certain limited purposes electricity can be considered as a fluid, but the limitations should always be borne in mind.

Colonel Moore-Brabazon, moving with the times, puts certain questions as to our fundamental entities of to-day, the proton and the neutron, and wants their properties explained in anthropomorphic terms of likes and dislikes, and so on, or at any rate, in terms of the behaviour of massive bodies, which they resemble as little as electricity in bulk does a material fluid. The problem is not to explain atomic and nuclear electro-dynamics in terms of macroscopic charges and their properties, because we know that this cannot be done, but to find out with what particles we can form a consistent scheme of action for the experimenter, and with what properties we must endow these particles.

Workers on nuclear problems have decided that they must have, among other things, protons and neutrons. Now, if I understand Colonel Moore-Brabazon, he wants to know how the neutrons and the positively charged protons can be packed together, because if they have the properties of macroscopic charges the assemblage will be unstable. We know, however, that they have not these properties, and our task is to form a consistent scheme which shall cover these properties and shall also cover other aspects of atomic electro-dynamics. We may have to assume certain entities to help us along temporarily in our difficulties, such as the unsatisfactory neutrino, but the unsatisfactoriness of the neutrino is not that it has properties inconsistent with the laws of classical

electricity, but that it has no properties at all, except those assumed *ad hoc*.

We can get over Colonel Moore-Brabazon's difficulty about "the charge on the proton" by calling it "the charge of the proton", to which nobody will object. Whether we talk of the neutron containing an electron is to some extent a matter of words, just as whether we talk of a rocket as containing the stars is a matter of words. What we want to know is under what conditions the neutron can be transformed into, or replaced by, a proton and an electron. To explain this behaviour we have to resort to sets of rules evolved by studying atomic and macroscopic phenomena and to accept the "non-reasonable" conception of the quantum theory, in its modern wave-mechanical form. Thus I can tell Colonel Moore-Brabazon that it is held in some quarters that the proton and the neutron represent two different quantum states of one entity: I can talk to him of Fermi and of Bose statistics, and allied rules to help us to decide as to the structure of the nucleus—as to whether, for example, it contains electrons. This would, however, be to introduce difficult detail that he might regard as an attempt to throw dust in his eyes. I prefer to say, quite generally, that some sort of special rules are required, and that, whatever these are, they are to be obtained by generalizing certain experimental results, and not by reasoning from the classical laws of electricity. In Rutherford's words "the atomic nucleus is a world of its own [my italics. E. N. da C. A.] in which a number of particles like protons and neutrons are confined in a minute volume and held together by very powerful unknown forces. Vigorous attempts are in progress to adapt existing [that is, quantum-mechanical] ideas to explain the structure of atomic nuclei, and some success has been obtained in a few simple cases".

If Colonel Moore-Brabazon is still unsatisfied I beg him to cast his eyes back to Newtonian days. Would he in those days have wanted strings tied to the planets to pull them towards the sun, on the ground that a body cannot act where it is not? He cannot pull my nose (though perhaps he may pull my leg) at a distance; how then can the sun pull the planets? In fact, the conception of action at a distance gave much trouble to very acute brains*. Jean Bernoulli, for example, never accepted it. However, quite apart from any speculations as to the nature of gravitational forces, such as Einstein's recent hypothesis, the laws of interplanetary force were worked out on the assumption that a body *could* act where it was not, with such satisfactory results that the hypothesis of universal gravitation now offers no trouble to anybody.

I cannot promise Colonel Moore-Brabazon that all men of science will share my views, but there they are, for what they are worth. Now, perhaps, in return, Colonel Moore-Brabazon will give me a logical statement of British foreign policy in the last ten years, which has puzzled me as much as the nuclear mechanics of the last ten years has puzzled him.

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* The reader who wishes to see how slowly Newton's ideas penetrated may consult M. Brunet's learned "L'Introduction des théories de Newton en France au XVIII^e siècle".

Internal Friction of Wires

WORKING with the transverse vibrations of wires of glass, steel, brass, aluminium and silver, Bennewitz and Rötger¹ have found that the internal friction has a maximum at a frequency f_0 characteristic of each wire. They have found, in fact, that the internal friction varies with frequency f approximately as

$$A \frac{f_0 f}{f_0^2 + f^2} \quad (1)$$

The purpose of this letter is to point out that the internal friction measured by Bennewitz and Rötger is a direct consequence of the entropy increase associated with the flow of heat from the compressed to the extended side of the wire. f_0 is interpreted as the reciprocal of the time of relaxation for the establishment of temperature equilibrium across the wire. The theory of this thermo-elastic internal friction has been discussed by me² for the case of a reed. An extension of the theory to wires is being published elsewhere. It is found that Q^{-1} for both reeds and wires (which is equal to the logarithmic decrement λ of Bennewitz and Rötger multiplied by $\log_e 10/\pi$) is given by (1), with

$$A = (E_S - E_T)/E_S,$$

where E_S and E_T are the adiabatic and isothermal Young's moduli, respectively. In the case of wires, f_0 is given by

$$f_0 = (q^2/2\pi)Da^{-2} = 0.539 Da^{-2},$$

where D is the thermal diffusion constant of the material, a the radius of the wire, and q the first root of the equation

$$(d/dx)J_1(x) = 0,$$

namely, 1.84.

Not only does the thermo-elastic effect give a satisfactory qualitative interpretation of the experiments of Bennewitz and Rötger, but also, as shown by the accompanying table, it gives good quantitative agreement.

Type of wire	Glass	Steel	Brass	Aluminium	Silver
$2a$ in mm.	1.25	1.0	1.25	1.5	1.01
f_0 , observed	0.66	25	40	83	240
$0.539 Da^{-2}$	0.5-0.6	27	45	84	350
$A \times 10^3$, observed	8.7	2.6	4.4	5.2	6.0
$(E_S - E_T)/E_S \times 10^3$		1.9	3.2	4.6	3.7

[†] A has been obtained by multiplying λ_{\max} of Bennewitz and Rötger by $2(\log_e 10)/\pi = 1.46$.

It is of particular interest to note that the frequency, f_0 , at which the internal friction has a maximum is not a constant of the material, but varies inversely as the square of the radius of the wire.

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¹ Bennewitz, K., and Rötger, H., *Phys. Z.*, **37**, 578 (1936).

² Zener, C., *Phys. Rev.*, **52**, 230 (1937).

Capture of Slow Neutrons in Light Elements

By means of a small boron-lined ionization chamber we have studied the density distribution of neutrons around a source (Ra + Be) placed in a large container filled with a hydrogenous liquid¹. From the measured distribution the total number of neutrons present at any instant is obtained by integration. This figure does not depend on the scattering properties but only on the capture cross-sections of the

nuclei constituting the liquid. If a constant number of neutrons is emitted from the source, then the mean number present at any instant is inversely proportional to the total capture probability.

By using liquids containing the same constituents in different proportion we have been able to separate the capture effects due to the single constituents. First we compared benzene (C_6H_6) and liquid paraffin ($CH_{1.17}$, according to chemical analysis). The numbers of neutrons in these two liquids were found to be inversely proportional to the respective hydrogen densities; it follows that the capture cross-section of carbon must be much smaller than that of hydrogen. A similar result was found for oxygen, on comparing benzene and water. Through the kindness of a loan of 60 litres of heavy water of 10 per cent deuterium oxide content, from the Norsk Hydro-Elektrisk Kvälstofaktieselskab, Oslo, we were enabled to include deuterium in our experiments; also in this case no measurable capture was detected. In a 7.6 per cent solution of ammonium nitrate in water, however, the capturing action of the nitrogen could be easily observed and measured.

We have also made measurements with aqueous solutions of boric acid and lithium hydroxide. Since the capture cross-sections of boron and lithium have been determined from experiments with beams of thermal neutrons, our measurements can be used to obtain absolute capture cross-sections for all the light elements quoted above. The results are collected below.

Capture cross-sections σ_c for neutrons of velocity 2.2×10^4 cm./sec.

Element	H	D	C	N	O
$\sigma_c \times 10^{24}$ cm. ²	0.27 ± 0.02	< 0.03	< 0.01	1.3 ± 0.3	< 0.01

Our value of σ_c for hydrogen is somewhat smaller than the value given by Amaldi and Fermi (0.31×10^{-24} cm.²) which furthermore corresponds to a neutron velocity of 2.5×10^4 cm./sec. and should therefore be increased by a factor of 1.13 to be compared with our value. On the other hand, from neutron beam experiments we get a somewhat larger value (48 instead of 43×10^{-24} cm.²)¹ for the scattering cross-section of hydrogen. For the mean number of collisions suffered by a slow neutron in paraffin before getting captured we find 205 ± 20 (instead of 140)¹.

Our value of σ_c for nitrogen agrees with the value found² by counting the protons emitted in the reaction $^{14}N + ^1_0n = ^{14}C + ^1_1H$.

We may mention another result of our investigations. We have compared the yield of photo-neutrons from beryllium and deuterium irradiated by gamma rays from radium, with the yield from a mixture of radon and beryllium. Assuming the latter yield to be 20,000 neutrons per second per millicurie, we find for deuterium a cross-section of $\sigma_{\gamma,n} = 7 \times 10^{-28}$ cm.² for photo-dissociation by quanta of 2.2 Mev. energy. For beryllium, where two gamma lines of 1.8 Mev. and 2.2 Mev. are sufficiently energetic, we find $\sigma_{1.8} + 0.3\sigma_{2.2} = 2 \times 10^{-27}$ cm.².

A detailed account is to appear shortly in the *Proceedings of the Royal Academy, Copenhagen*.

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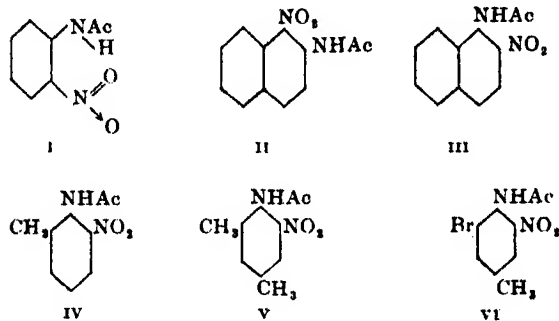
¹ Amaldi, E., and Fermi, E., *Phys. Rev.*, **50**, 899 (1936).

² Burcham, W. E., and Goldhaber, M., *Proc. Camb. Phil. Soc.*, **32**, 682 (1936).

Evidence of Restricted Rotation about the N—C Bond in 2:6-Disubstituted Acetanilides

THE failure¹ to effect optical resolution of substituted anilines having two large *ortho* groups has left unconfirmed the theoretical possibility of restricted rotation about the nitrogen-nuclear single bond in such compounds. That such steric effects are indeed present in suitably constituted molecules is now proved by a method entirely independent of optical activity.

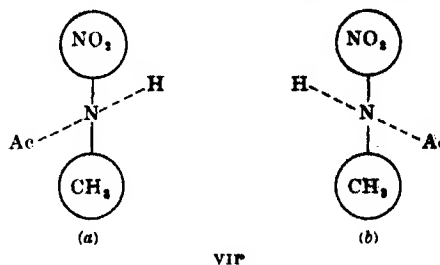
It has been shown² that the molecular association of amides is due to the bonding effect of the amide-hydrogen atoms, the complete replacement of which effectively checks association. Subsequent work has shown that, in the case of anilides, certain *ortho* substituents are effective in preventing association, and it is significant that such substituents are invariably hydrogen-acceptor groups such as $-\text{NO}_2$, $-\text{N}=\text{N}-$, $-\text{COOEt}$. In such compounds it is evident that the hydrogen atom responsible for association is no longer available for this purpose, it being engaged in chelate ring-formation, such as that depicted in *o*-nitroacetanilide (I). During these experiments an unexpected difference was revealed between the behaviour of 1-nitro-2-acetnaphthalide (II) and the isomeric 2-nitro-1-acetnaphthalide (III). The former is unimolecular, having a lower melting point and greater solubility in hydrocarbon solvents than the latter, which is associated. This led us to suspect steric influences, and to investigate other substances in which similar steric effects might be expected.



The results showed with surprising regularity that although *o*-nitroacetanilide (I) is unimolecular, the substitution of a second *o*-substituent in this compound (such as in IV, V and VI) restores the tendency to associate. The inevitable conclusion is that the amide-hydrogen atom in III, IV, V and VI is deflected by steric interference between the acetyl group and the methyl group (or the bromine atom) too far away from the neighbouring nitro-group to permit of chelate ring-formation, thus leaving the hydrogen atom free to exert its intermolecular bonding effect.

The sensitiveness of this method of detecting restricted rotation as compared with the classical method of optical resolution can best be explained by considering the example of 3-nitro-2-acet-toluidide (IV). A plan of this molecule as seen from a point above the nitrogen atom and remote from the benzene nucleus is shown in VII, the single line connecting the two *ortho* substituents ($-\text{NO}_2$ and $-\text{CH}_3$) representing the plane of the benzene nucleus. The size of the two *ortho* groups may be such as to limit, but not absolutely prevent, the rotation of the H—N—Ac axis from the position shown in VII a to that shown in the enantiomorph VII b. Any such rotation will

bring about a more or less rapid racemization. Nevertheless, only in a very small proportion of molecules intermediate between (a) and (b) is chelation between H and NO_2 possible, with the result that the majority of the molecules show association.



In other words, whereas the chance of resolving such a compound depends upon the non-conversion, or at least the slow rate of conversion, of molecules of type (a) into those of type (b), the test now applied is completely independent of such conversions, and depends solely on the inclination (in whatever direction) of the H—N—Ac axis to the plane of the benzene nucleus.

The degree of association of these compounds was measured cryoscopically in naphthalene, and the relevant figures will be published elsewhere.

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¹ Tuan, Hsü, and Hsü, *J. Chinese Chem. Soc.*, **4**, 131 (1936).

² Chaplin and Hunter, *J. Chem. Soc.*, 1114 (1937).

Liver Extract and Hæmoglobin in Rats

RECENTLY Tschesche and Wolf¹ have stated that rats, made anæmic on a diet consisting wholly of milk, respond differently to iron and copper and to liver extracts known to be clinically active in the treatment of pernicious anæmia. According to these authors, erythrocyte and leucocyte counts and hæmoglobin are all increased by the metals, while cell counts but not hæmoglobin are increased by the liver extract.

Preliminary attempts in these laboratories to confirm the results of Tschesche and Wolf have led to the surprising result that liver extract produces an apparently significant increase in the hæmoglobin of rats with milk anæmia, while leaving the cell count as low as in untreated animals. It is proposed to publish fuller details of this investigation elsewhere.

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¹ Tschesche, R., and Wolf, H. J., *Z. physiol. Chem.*, **243**, 21 (1937).

Crystal Structure and the Magnetic Anisotropy of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

FROM a discussion of the magnetic susceptibilities of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ powder at different temperatures, Jordahl¹ concluded that the crystalline electric field acting on the Cu^{++} ion in the crystal should be predominantly cubic in symmetry, and further, from

the sign of the potential due to this field which fits the magnetic data, that the field should correspond to an octahedral distribution of six equal negative charges around the Cu^{++} ion. This result is not obvious from general structural considerations, since the crystal is triclinic, and there are five molecules of water and one SO_4 group associated with each Cu^{++} ion. The result, however, has been beautifully verified by the X-ray studies of Beever and Lipson¹ on the structure of the crystal. The Cu^{++} ion is found to be at the centre of an octahedron of six negatively charged oxygen atoms. Four of them belong to four water molecules, and they form a square with the Cu^{++} ion in the centre. The other two, which are contributed by two sulphate groups, are located centrally above and below this square.

Now this octahedron is only approximately regular, the oxygens of the water molecules being closer to the Cu^{++} ion than the other two. The crystal field acting on the Cu^{++} ion should therefore deviate considerably from cubic symmetry, and its intensity along the normal to the plane of the water molecules should be less than for directions in the plane. Now there are two such Cu^{++} ions in the unit cell of the crystal, and the two corresponding squares of water molecules make with each other an angle of 82° , which is nearly a right angle. One would therefore expect: (1) that the crystal should be magnetically anisotropic, which is a trivial result since the crystal is triclinic; (2) that two of the principal suscepti-

bilities of the crystal should be nearly equal, and greater than the third (that is, the magnetic ellipsoid should be approximately an oblate spheroid); (3) that the axis of this spheroid should lie along the line of intersection of the planes of the two squares of water molecules in the unit cell. All these conclusions have been verified experimentally².

The directions of the two nearly equal axes of the ellipsoid can also be predicted from the fine structure of the crystal: the shorter of them should lie in the plane bisecting internally the two squares of water molecules. Since the angle between the two squares differs by only 8° from a right angle, this last conclusion cannot be accepted with the same confidence as the others. From a study of the magnetic anisotropy for a number of planes in the crystal, we have recently determined the directions of these two magnetic axes, and they too lie nearly as predicted from the structure.

Thus the magnetic data confirm in a striking manner the structure proposed by Beever and Lipson for the crystal.

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¹ *Phys. Rev.*, **45**, 87 (1934).

² *Proc. Roy. Soc., A*, **146**, 570 (1934).

³ Krishnan and Mookherji, *Phys. Rev.*, **50**, 800 (1936).

Points from Foregoing Letters

Prof. A. C. Cuthbertson, Geoffrey Gee and Prof. E. K. Rideal find that pure vinyl acetate does not polymerize measurably at 100°C . even in the presence of oxygen. A peroxide derived from acetaldehyde, however, catalyses the reaction. The authors suggest that the discrepancy in the findings of various observers between the rate of polymerization of gaseous and liquid styrene may be likewise explained by the presence of a peroxide catalyst in the liquid phase.

J. S. Kennedy describes how solitary locusts belonging to the species *Schistocerca gregaria* on the Red Sea coast, crowd together into patches of dense but uneven vegetation, and this fortuitous concentration brings about the change from the solitary to the gregarious 'phase'.

A photomicrograph of a horizontal section of skin from a four months' old Merino lamb is submitted by Dr. A. B. Wildman in support of the late Prof. J. E. Duerden's view that the 'trio' follicles which at first produce the coarse birth-coat fibres may later produce a fine non-medullated wool fibre.

The appearance of male sex organs in female guinea pigs after the almost complete removal of the ovaries is described by Prof. A. Lipschütz. This, the author points out, does not exclude the possibility that male hormones are produced in the ovary.

Taking the elimination of Congo-Red dye from the body as a measure of the activity of the reticulo-endothelial system, C. Wetzler-Ligeti and Dr. B. P. Wiesner find that certain aqueous pituitary extracts stimulate the activity while other extracts of the anterior lobe of the pituitary having thyreotropic activity and containing a proportion of sex hormones lower the activity.

Following upon theoretical considerations of entropy increase, Dr. C. Zener calculates the frequency of transverse vibrations for which the internal friction is a maximum, in the case of wires of various materials (glass, steel, silver, etc.) from the known values of their Young moduli; he submits a table showing that the values obtained agree with those experimentally determined by Bennewitz and Rötger.

From measurements of the density distribution of neutrons around a source, in different hydrogenous liquids, Drs. O. R. Frisch, H. von Halban, jun., and Jergen Koch have obtained values for the capture cross-sections of hydrogen and nitrogen, for neutrons of thermal energy; in the cases of deuterium, carbon and oxygen, upper limits for the capture cross-sections have been established. Furthermore, the cross-sections of deuterium and beryllium for photo-dissociation by the gamma rays of radium have been determined.

Whilst certain *o*-substituted acetanilides give indication of chelate ring-formation between the two neighbouring groups, Dr. L. Hunter and H. O. Chaplin find that substitution of a group in the second *ortho* position prevents chelation. This fact is interpreted as evidence of restricted rotation about the nitrogen-nuclear single bond in 2 : 6-disubstituted acetanilides.

From a consideration of the fine structure of the $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ crystal (triclinic) analysed by Beever and Lipson, Prof. K. S. Krishnan and A. Mookherji locate the directions of the maximum and the minimum susceptibilities of the crystal, and further state that the intermediate principal susceptibility should be almost equal to the maximum. These results have been verified experimentally.

Research Items

Ethnography of the Tanaina

IN continuation of his research among the Northern Athapascan Indians, Dr. Cornelius Osgood spent the summer of 1931 and part of that of 1932 with the Tanaina of Cook Inlet (Yale Univ. Pub. in Anthropol., 16, 1937. Oxford Univ. Press. 13s. 6d. net). The Tanaina are a nation of related subdivisions or tribes, of which, broadly speaking, there are seven. The name means "the people", as distinct from either Eskimo or Europeans. Their culture has suffered much disintegration from European contacts during a period of one hundred and fifty years. Their language belongs to the Athapascan stock, being most closely related to that of their neighbours to the north-west, the Irgulik Athapascans. It is unquestionable that the neighbouring Eskimo have had some physical, cultural and linguistic effect on them. No anthropometric study of them has been made, but they are taller than the Eskimo. A full-grown man of less than five feet eight inches is rare. The nose is prominent, frequently aquiline, the lips full, the skin darker than the Eskimo. The most important article of diet is fish, especially salmon; but the Tanaina are unique among the Athapascans in having access to sea mammals, seal, sea lion, etc. The meat of the white whale is much relished, but as they have not the correct 'medicine' for its killing, they buy it with furs. Of land animals they hunt the forest fauna, mountain sheep and goats, bear, etc. For vegetable foods they eat a variety of berries, spruce buds, wild rice, wild 'peas', fern roots, and, most important of all, the *klila*, a parsnip-like root, which is obtained only from the North Inlet, but is the principal article of trade and transported as such from one end of the country to the other.

Newfoundland Amphipoda and Decapod Larvæ

MISS NANCY FROST describes some interesting material collected by the S.S. *Cape Agulhas* in Newfoundland waters in 1931-35. The list of amphipods given includes a new species of *Hippomedon* (*H. stephensenii*) and a specimen of *Paramphithoe cuspidata* which differs considerably from the type. The decapod larvæ are numerous, the genus *Spirontocaris* being conspicuous and five species differentiated, although three of them could not be referred to distinct species. *Pandalus montagui* was the most abundant of all the larvæ and *P. borealis* fairly common. Two distinct megalopæ belonging to *Hyas* were found, one being *Hyas coarctatus*, and it is almost certain that the second is *Hyas araneus*, but this differs from *H. coarctatus* in having two small posterior dorsal spines on the carapace instead of one large one. If this identification be correct, this clears up much that was obscure in the previous descriptions. A young stage of *Latreutes fucorum* is figured, two specimens having been secured, and there is a post-larval (or young stage) of *Spirontocaris grandlandica*, which fills a gap in the hitherto known life-history. Miss Frost finds that the mandibular palp is present in the post-larva of both species of *Pandalus*, which is very much earlier than it appears in some species of *Spirontocaris*.

New Mutation in *Drosophila*

A MUTATION in egg-shape of *Drosophila funebris* described by Prof. F. A. E. Crew and Dr. C. Auerbach (*Proc. Roy. Soc. Edin.*, 57, Part 3) provides several points of interest. The eggs are shorter and broader than normal, and spheroidal in shape, the four attached filaments being very much shorter. The ability to produce these eggs is inherited as a recessive condition, and is found to be widespread in the wild population. The fecundity of females which lay spheroidal eggs is also very low. Whereas normal females lay more than 1,000 eggs, these lay mostly 30-50. The curve of egg production is also different and the spheroidal eggs are more variable. The correlation between length and width of the egg is positive in normal, negative in spheroidal eggs. This is the first mutation in egg-shape to be found in *Drosophila*, and as the females which produce these eggs are themselves normal in appearance, special tests are required to show the manner of inheritance.

Cobalt Chloride Treatment of Sheep

IN an earlier paper it had been shown that a lamb sickness in Southland, New Zealand, known locally as Morton Mains disease, could be successfully controlled by the use of small quantities of cobalt chloride administered in drench form. While drenching is reliable as a research method, since it ensures that every animal gets its proper dose, it has disadvantages in farm practice owing to the time and trouble involved. J. K. Dixon, of the Cawthron Institute, has now been able to show (*N.Z. J. Sci. Tech.*, 18, 892-97) that a salt lick made by spraying a solution of 4 oz. of cobalt chloride on a ton of dairy salt can be successfully used as an alternative method. Ewes and lambs supplied with such a lick kept in perfect health, but the use of it during pregnancy only was not sufficient to maintain optimum growth of the lambs during the following summer. The cost is not likely to exceed 4d. per sheep per year and great saving in labour is attained.

The Root-Knot Eelworm

MR. G. FOX WILSON has collected a large amount of information about the root-knot eelworm, *Heterodera Marioni* Goodey (*J. Roy. Hort. Soc.*, 62, Pt. 8, August 1937). The pest was formerly regarded as a pest of glasshouse plants, but it is now known to attack a wide variety of outdoor crops. It frequently appears on groundsel, chickweed and shepherd's purse, weeds which may spread the pest in unhygienic gardens. The life-cycle is described, and various methods of dispersal, such as the distribution of infected soil upon the gardener's boots or tools, and the return of greenhouse compost to the garden, are discussed.

Heteroauxin and Cambial Activity

As foreshadowed in an earlier paper (A. B. Brown, *Canadian J. Res.*, 15, No. 1), an interesting series of experiments has been performed on the stimulation of the cambium of dormant branch segments of *Populus balsamifera* L., by the application of

heteroauxin (A. B. Brown and R. G. H. Cormack, *ibid.*, 15, No. 9). Bridged rings were cut in the bark in the middle of the segments, and the amount of new xylem cut off by the reactivated cambium was clearly visible on the surface of the old wood when the bark was stripped from the segment and the latter dried. In this manner xylem patterns were obtained showing that the induced activity was in all cases similar to that produced by wounding alone but more extensive. There was local activity at the three regions of wounding, namely, the ring and the top and bottom of the segments, in the controls; but there was a much greater, though still local, activity in the cases where heteroauxin had been applied. The influence of the latter was manifested at points some distance from the region of application, but without any renewed activity on the part of the intervening cambium.

Recent American Earthquakes

THE recent issue (July 1937) of the *Bulletin* of the Seismological Society of America contains several useful papers on recent earthquakes in North and South America. J. E. Ramirez (pp. 211-223) describes ten earthquakes in the department of Nariño, Colombia, within less than a year (1935-36), three of them of destructive strength. The region is one that has been visited by many great earthquakes (of which a list is given) since the Spanish conquest. A semi-destructive earthquake on July 15, 1936, with its origin near the boundary of the States of Washington and Oregon, is studied by B. H. Brown (pp. 205-209). Many tombstones in the cemeteries were rotated, about 70 per cent of them in the clockwise direction, but it is noted that some stones in close proximity were rotated in opposite directions. P. Byerly and J. T. Wilson (pp. 225-229) give a valuable list of 64 earthquakes in northern California in 1936. Many of the epicentres, as shown on the map, lie along well-known faults. The earthquakes of the New Madrid region (the scene of the great earthquakes of 1811-12) are receiving careful attention. F. Robertson (pp. 231-239) describes two slight shocks during the first half of the present year. The earlier (January 30) occurred, like a recent predecessor (May 12, 1929), at the height of the flood of the Ohio and St. Francis rivers. Its epicentre seems to lie on the edge of the Tiptonville dome, one of the largest areas partly uplifted during the earthquakes of 1811-12.

Secular Trends of Temperature

DURING the last few years, a number of investigators have discussed the secular trend of temperature over a long series of years at various places in Europe and America, generally with the aid of moving 20-year averages of mean temperature. In Prof. Note No. 77 of the Meteorological Office (London: H.M. Stationery Office), Miss L. F. Lewis gives a very thorough analysis of one of the best records for this purpose, that obtained at the Radcliffe Observatory, Oxford. The period covered is 1815-1934. The observations had been corrected for changes of instrument and exposure by certain of the trustees of the Observatory. The analysis covers the year and the four seasons separately, and brings to light a number of interesting facts. The annual curve of 20-year moving annual averages for the whole 120 years reveals three marked warm and two marked cold periods. The third warm period is the one that

we have been enjoying during the present century and is not very different in intensity from the two earlier ones; but when we come to the separate seasons it is seen that the mildness of the winters of the past forty years is without precedent. The summer and winter are the seasons which follow least closely the annual curve. The summers of the present warm spell have until the last few years been on an average decidedly cool, so that this latest warm spell is also one of notable equability. No previous 20-year means of the difference between mean summer and mean winter temperature have been so low as those for 20-year periods ending between the years 1912 and 1934. A definite answer to the question whether our climate is becoming milder cannot, of course, be obtained from these curves, but they certainly correct the impression of such a change given by a comparison between the latter part of the last century and the present century up to date.

Hydraulic Cements

IN a discussion on chemistry and building research in Section B of the British Association at Nottingham, Dr. F. M. Lea referred to some of the main problems met with in cement technology. He was dealing with hydraulic cements—those which set and remain permanent under water—and confined himself to Portland cement. From phase equilibrium studies of binary, ternary and quaternary oxide systems and from the application of microscopic, X-ray and other methods of examination the major crystalline compounds have been found to be $3\text{CaO} \cdot \text{SiO}_2$, which is mainly responsible for the development of strength in the early stages of hardening, $2\text{CaO} \cdot \text{SiO}_2$, which hydrates slowly and develops strength in the later stages, $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, and sometimes $5\text{CaO} \cdot 3\text{Al}_2\text{O}_3$, and $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$. On hydration, it is probable that a hydrated dicalcium silicate or a $3\text{CaO} \cdot 2\text{SiO}_2 \cdot \text{aq}$. compound is formed, free calcium hydrate being liberated, and a hydrated tri- or tetra-calcium aluminate produced. Calcium-sulpho-aluminate is also formed by reaction with the gypsum used to control the set. When, as in practice, a limited proportion of water is used, the hydration products appear to be mainly gelatinous, but the view that this gel has a microcrystalline structure is as yet unconfirmed. Heat of hydration is greatest for the compound $3\text{CaO} \cdot \text{Al}_2\text{O}_3$ and diminishes in the order $3\text{CaO} \cdot \text{SiO}_2$, $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$, $2\text{CaO} \cdot \text{SiO}_2$. Moisture content considerably affects the physical properties of the set cement. Theories concerning volume changes were also discussed.

Polymorphism under Pressure

THE issue of the *Proceedings of the American Academy of Arts and Sciences* of July contains a paper of ninety pages by Prof. P. W. Bridgman of Harvard on the polymorphic transitions of thirty-five solid inorganic substances under pressures up to 50,000 atmospheres and at temperatures from -100°C . to 200°C . The substance under test is placed in a cylindrical hole about 1 cm. long and 0.6 cm. diameter in a cylinder of 'solar' steel about 4 cm. long and 3 cm. diameter, and the pressure is applied by a 'carboly' piston forced into the hole by a hydraulic press. The pressure is determined from that in the press and the areas of the sections of the pistons of apparatus and press. To enable the cylinder to withstand the pressure without fracture, it is made slightly conical and the pressure applied

forces it into a wide collar of chrome vanadium steel in which a thermo-couple is placed to measure the temperature. The change of volume of the substance on transition is determined from the movement of the piston. The whole apparatus is surrounded by an oil bath. For the substances examined the transition of phase takes place in most cases at higher temperatures as the pressure is increased, but there are many exceptions. The change of volume may decrease or increase with increase of pressure, and Prof. Bridgman concludes that polymorphism is "an essentially haphazard phenomenon".

Densities of Mixtures of Light and Heavy Water

IN many lines of investigation, the proportions of light and heavy water in a mixture are required, and the simplest method of finding these proportions is a determination of density. L. G. Longworth (*J. Amer. Chem. Soc.*, 59, 1483; 1937) has determined the densities of several mixtures of light and heavy water and finds that the two liquids mix without volume change, so that the volume of a mol of the solution may be expressed in terms of the mol fractions of the components by the formula $V_a = N_1v_1 + N_2v_2$, where the subscripts 1 and 2 refer to the light and heavy constituents. The actual molal volumes of the solutions are given by the relation $V = (N_1M_1 + N_2M_2)/d$, where M is the molecular weight and d the observed density. The expansions on mixing, $V - V_a$, were found to be zero within the limits of precision of the density determinations. The atomic weights used were O = 16.000, H = 1.00756, D = 2.01309, the atomic weight of hydrogen being given a correction for the deuterium normally present. If ΔS is the value of $1 - d_2^2/d_1^2$, referred to the density of deuterium-free water, the two equations may then be combined to give a simple relation between ND_2O and ΔS , namely, $ND_2O = \alpha \Delta S / (1 - \beta \Delta S)$, in which $\alpha = 9.235$ and $\beta = 0.0309$. This equation makes it possible to determine the proportions of light and heavy water in mixtures of the two.

Uranium Dioxide Starting Resistances

IN starting an ordinary D.C. motor, a 'starting' resistance is placed in series with it and this resistance is gradually diminished by hand as the speed of the motor increases, so as to maintain so far as possible a constant current through the motor. In the autumn issue of *A E G Progress*, a description is given of new starting resistances made of uranium dioxide (urdox). This material was discovered by two German engineering firms working in collaboration—the Allgemeine Elektrizitäts-Gesellschaft (A E G) and the Osram Gesellschaft. Unlike ordinary metals, its resistance diminishes as the temperature rises, and as this fall occurs rapidly, a 'resistor' of this material when placed in series with a motor keeps the current constant during the starting period. The long life of these resistors is due, among other things, to the fact that during operation they heat only a few hundred degrees and never become red hot. A usual value for the resistance of one type of these resistors is one ohm when hot and fifty ohms when cold. Their starting times vary between half a second and 30 seconds, whilst their cooling periods last for some minutes. These resistances can also be thermally and electrically balanced so as to become voltage regulators. The cost of installing them in existing installations is very low. It is practically only necessary to provide lamp-holders.

Service Area of a Radio-telegraphic Transmitter

THE July issue of the *Amalgamated Wireless (Australasia) Technical Review* contains a paper entitled "The Service Area of a Long Wave Telegraphic Transmitter" by A. L. Green. This paper discusses the factors of aerial efficiency, wave propagation and interference from atmospherics, which determine the delivery of a reliable day and night broadcast telegraphic service to all points within a radius of about 5,000 miles from the transmitter. In the study of this problem, a large amount of published data has been analysed and the results have confirmed two assumptions made in the author's calculations. The first of these relates to the use of Watson's propagation formula over a large range of wave-lengths, while the second is that the intensity of interference from atmospherics is directly proportional to the wave-length to which the receiver is tuned. As a result of the author's calculations, it is concluded that the optimum wave-length for the service contemplated is about 4,000 metres, and that the supply of 100 kilowatts of power to an aerial of an effective height 100 metres is sufficient. The use of a wave-length shorter than the optimum improves the service at the shorter distances; while a longer wave-length is necessary only if the service requires to be extended to very great distances. Under the conditions described above, the radiated field should provide a signal to noise ratio greater than unity at all points within a radius of 5,000 miles from the transmitter.

Geometry of Pipe Joints

SOME interesting geometrical problems arise in making neat and practicable bend connexions in sheet-material between one cylindrical pipe or duct and another. For those who are concerned with work of this kind or with analogous problems, a pamphlet by W. Sellar entitled "The Geometry of Conical Pipes, Bends and Joints" (London: The Draughtsman Publishing Co., Ltd. 2s. net) will be found of positive assistance. In a pipe of uniform diameter, the arrangement of elbows and bends of various degrees of smoothness presents no special difficulty, and several of the methods in use are described and illustrated. When, however, the pipes to be connected are of different size and meet at an angle, the choice of a wrapped surface to which a flat sheet can be bent and which will form a convenient and pleasing intersection with the given surfaces is distinctly more complex. The solution lies in making use of the property that the ellipse is a plane section both of the cone and of the cylinder. The appropriate ellipse is obtained by arranging that the cone and the cylinder are both tangent to a common sphere, and in the pamphlet it is shown how, in a number of different problems, one or two or even more spheres can be used to obtain connexions for complex systems of pipes and branches in such a form as to minimize loss of pressure. The basic principle of this method of construction is clearly explained but no geometrical proof is given—nor for the purpose in view is it required. It is not clear, therefore, why a long list of what are described as essential points is given for these, and the figures illustrating them tend rather to complicate than to clarify the apparent simplicity of the method. The explanations given of the solutions of the numerous problems dealt with are, however, concise and clear, and are illustrated by drawings which alone would form a sufficient guide to a draughtsman.

The Mellon Institute, Pittsburgh*

THE Mellon Institute of Pittsburgh has published in pamphlet form an account of the dedication of the new building on May 6-7, 1937 (*NATURE*, May 15, 1937). In the introductory address, the Hon. Andrew W. Mellon paid tribute to Dr. Robert Kennedy Duncan, who initiated the system of industrial fellowships; and to his book "The Chemistry of Commerce", from which Mr. Mellon derived his original interest in the scheme. Discoveries and inventions, rather than governmental or political action, he said, "increased production, lowered costs, raised wages, elevated the standard of living".

The addresses of Dr. Irving Langmuir, Dr. Harold C. Urey and Dr. William P. Murphy—all Nobel laureates—are reprinted. On the subject of chemical research, Dr. Langmuir said that it is a common experience of industrial laboratories that the cost of research on a problem, up to the point where a patentable invention is made, is only a small fraction of that required to make the invention commercially successful, and for this reason such laboratories cannot devote a large part of their effort to fundamental research. The application of modern physics to chemistry, he suggested, is receiving only a small fraction of the attention it deserves. The greatest field which would open itself within the next decade in chemical research would be in the application of the new physical methods to the study of the familiar properties of matter, which have been neglected by the physicist for many years.

"We need more fundamental knowledge, in terms of atomic structure, of the mechanical properties of metals, insulating materials, plastic materials, and in general, chemical substitutes of high molecular weights. The use of X-rays, electron diffraction, and electron optics . . . should open new fields to chemists."

Dr. Urey scheduled ten important technical processes developed in recent years. Two of fundamental importance, the fixation of atmospheric nitrogen and the hydrogenation of coal, are due largely to German men of science. As to the first, it is estimated that the I. G. Farbenindustrie has expended 150,000,000 gold marks in the development of the process. Synthetic woollen textiles are coming—already two Italian regiments are wearing imitation wool uniforms made from the casein of skimmed milk. Would artificial wools ruin sheep farmers? More thought should be given to such problems consequential on scientific discovery. The limitation of scientific progress is fixed by the number of men available. "Find the men! That is the problem."

Another serious problem is the dissipation of raw material. We may have to grow our fuel supply by plants specially developed for the purpose; but the replacement of metals presents greater difficulties, pending the conquest of Mars and Venus. Referring to the ideals of scientific men, he said:

"We wish to abolish drudgery, discomfort, and want from the lives of men and bring them pleasure,

comfort, leisure and beauty. Often we are thwarted and our efforts perverted to other ends, but ultimately we will succeed. You may bury our bodies where you will, our epitaphs are written in our scientific journals, our monuments are the industries which we build, which without our magic touch would never be."

Dr. Murphy, co-discoverer with Dr. George R. Minot of the liver treatment for pernicious anaemia, commented on a weakness of medical research—the lag between discovery and its application to the cure of disease. The medical researcher has no incentive for the wide dissemination of his work, the profession as a whole showing no interest in commercial exploitation or in ensuring that the best product is put on the market. Progress in medical research has consequently been retarded in contrast to industrial research.

On the second day, a symposium on recent progress in science was held, including contributions from Dr. Frank B. Jewett on "Communication Engineering", Dr. George O. Curme, jun., on "Recent Progress in Synthetic Organic Chemistry", Sir Frederick Banting on "Early Work on Insulin", and Dr. William W. G. MacLachlan on "The Problem of Chemotherapy in Pneumonia". Dr. Curme said that the spectacular days of pioneering in the field of synthetic organic chemistry are passing, but the important task of its application to industrial and economic problems "is just getting under way". He instanced plastics as offering a wide field of work and regretted that "not one of our universities offers an adequate course of study, preparing students either for engineering application or research on plastic materials". Sir Frederick Banting said that the greatest advance in the treatment of diabetes since the discovery of insulin was due to Hagedorn and his colleagues, of Denmark, who in 1933-35 discovered that the addition of protamine to their insulin so delayed the action that the day's supply could be given in one injection. The presence of zinc was found by Scott to be necessary for this effect. It is estimated that more than a million people receive insulin each day. "Although much of the physiology is known, we do not yet know how insulin enables the body to utilize carbohydrates, nor do we know the cause of diabetes."

Dr. MacLachlan gave an interesting account of the systematic research carried on in the Institute on quinine derivatives for the treatment of pneumonia, 78 having been prepared and tested, a laborious process requiring about 20,000 white mice and other subjects. "As to our results for the past two years, we can say that hydroxyethylapocupreine appears to be effective in a considerable number of cases", especially in cases of pure infection. The original discovery that ethylhydrocupreine possesses strong powers of destroying pneumococci was due to Morganroth, in Germany, in 1911; but this preparation had the serious defect of producing blindness if given in adequate dosage. The object of the Pittsburgh workers, as of other workers in Japan and Germany, was to produce a derivative without this defect.

* Dedication of the New Building of Mellon Institute. Pp. 71. (Pittsburgh: Mellon Institute, 1937.)

Reaction Kinetics

ON September 13-15 the Faraday Society met under the presidency of Prof. M. W. Travers in the University of Manchester to discuss the modern theories and selected experimental aspects of reaction kinetics. The meeting was attended by a very large number of foreign guests and visitors.

The first section of the discussion was devoted to the theoretical treatments of reaction kinetics and resolved itself into a critical examination of the transition state or activated complex method and a comparison of the value of this method with that of the collision theory. The service done by this discussion lay in the emphasis on the differences which exist in the conceptual approach to the problem between those using the transition state method and those using collision theory.

The transition state method consists of two steps: the first is the construction of the potential energy surface for all configurations of the reacting atoms, and the second the calculation of the number of representative points which pass in unit time from the region of the potential energy surface that represents the initial state to that representing the final state of the reaction. The first step in this problem has been successfully carried out in a number of simple cases by the application of the semi-empirical method, developed by Eyring and Polanyi from London's theory. It was shown how the London theory can be modified so as to allow of an extensive use of empirical information and afford an interpretation of chemical reactivity in terms of bond strengths and the repulsion forces acting between atoms and molecules. A chemical change of the type $AB + C \rightarrow A + BC$ can be carried out by a complete dissociation of $AB \rightarrow A + B$ and the subsequent union of the atoms B and C . This would lead to an activation energy for the reaction equal to the dissociation energy of AB , no use having been made of the forces between atoms C and B . If, however, the centre C can be made to approach AB without overcoming large repulsion forces, then the attraction forces between atoms C and B can be utilized to reduce the activation energy. The driving force of a chemical change arises from the resulting bond formation BC , whereas the chemical inertia arises from the energy expended in achieving a configuration of atoms such that the driving force becomes operative. To attain this configuration, it is necessary to overcome the repulsion forces between AB and C and also the extension forces of the molecule AB .

The second step requires the definition of an 'activation surface' such that representative points crossing this surface lead to reaction. The number of points crossing this surface in unit time (reaction rate) is simply the density of points on the surface multiplied by their mean velocity perpendicular to the surface. The number of points in the 'activation surface' has been calculated by statistical equilibrium theory. Two very fundamental points were brought out in the discussion of this method.

1. The activated complexes AB (systems the representative points of which lie in the activation surface) are formed from molecules A^1 and B^1 of the initial state which possess sufficient energy in excess

over the normal molecules A and B . The transition state method assumes that equilibrium exists at all times between normal molecules and activated complexes, and this implies equilibrium between normal molecules and the energy-rich species A^1 and B^1 . It was emphasized that it is an assumption that the equilibrium numbers of energy-rich molecules A^1 and B^1 are maintained and not a condition which is necessarily fulfilled.

In most chemical reactions this condition is fulfilled since the equilibrium constant for a reaction can be expressed as the ratio of the reaction velocity constants in the forward and the reverse directions. Whenever the kinetic mass action law can be applied, it is justifiable to assume that the equilibrium number of energy-rich molecules is maintained and that the same conditions obtaining at equilibrium also hold when the products of reaction are removed.

2. In calculating the velocity of a chemical reaction by the transition state method, it is necessary to assume the validity of classical mechanics for the activated complex. Difficulties arise in the quantum treatment because of the fact that one cannot speak of a mean velocity of the representative point in the activation surface (Heisenberg indeterminacy principle) and, moreover, in certain cases tunnelling through the potential energy barrier may play an important part.

The statistical method of treating the activated complex has been translated into thermodynamic nomenclature and one speaks of the equilibrium constant K^\ddagger , the entropy change ΔS^\ddagger and heat change ΔH^\ddagger between the initial state and the activated complex. The heat change is the activation energy and the entropy change is related to the factor A in the velocity constant expression $k = Ae^{-Q/RT}$. This method has been used to account for reactions with abnormal A factors. An association reaction involving complex molecules has an abnormally small A factor, which in this theory is to be accounted for in terms of a negative ΔS^\ddagger between the initial state and the activated complex. The explanation in terms of the collision theory becomes identical with that of the transition state if the collision number is multiplied by a probability factor P which contains terms relating to the correct orientation, the correct 'internal phase' and the right internal energy distribution of the reacting molecules. These same factors appear explicitly in the partition functions which define the change entropy ΔS^\ddagger .

The denaturation of haemoglobin and egg albumen are reactions where the breaking of many weak bonds leads to the formation of an activated complex in which there is a much greater randomness of motion than in the initial state. This leads to a large positive entropy change, which means an abnormally high A factor.

Of great importance to any treatment of reaction kinetics is the study of the changes in the factors A and Q (of the Arrhenius equation) in a series of related reactions. An adequate theory must be able to include and explain the regularities which exist between changes in $\log k$, Q , A and $\log K$ (K is an equilibrium constant). When substituents are

introduced into, say, benzene derivatives, the velocity at which these compounds react is changed and these changes are nearly all due to changes in the activation energy. In other cases, however, superimposed on the changes in Q are variations in A , and frequently the two variations tend to compensate each other. The factor A shows marked variations due to changes of the solvent in which reaction occurs, and both A and Q have been found to vary with changes in the hydrostatic pressure. Changes in the velocity constants of a series of chemical reactions are often related to the changes in the equilibrium constants for the same or for a very similar series of reactions by $\log k = \alpha \log K + \text{const.}$ This gives an important approach to the understanding of the reactivity of organic compounds. Although a quantitative explanation cannot yet be given, it is just beginning to be possible to connect some of these relationships with changes in bond strengths, repulsion forces and chemical driving forces.

The last section of the discussion dealt with ionic and proton transfer reactions. The mechanism of both types of change has been considered in terms of 'extension' and repulsion forces. In the field of negative ion reaction, it has been possible to trace a relationship between the mechanism on one hand, and the chemical structure of the reactants and the physical conditions of reaction on the other. This study is of great value to the understanding of organic reactivity and the nature of the factors influencing it.

In the proton transfer reactions the small weight of the proton and the comparatively short distances between centres make a quantum mechanical 'tunnel effect' possible, but the experimental evidence available does not directly demonstrate the presence or absence of this effect. The comparison of reactions involving deuterons with those in which protons take part has led to valuable information about the mechanism of acid-base catalysis and proton transfer reactions in general.

Institution of Gas Engineers

AUTUMN RESEARCH MEETING

THE ninth Autumn Research Meeting of the Institution of Gas Engineers in London on November 2 and 3 had an interest above the average. The Institution research organizations have hitherto concerned themselves with current technical problems. This year the fortieth and forty-first reports of the Joint Research Committee of the Institution and the University of Leeds deal with problems of the future, and offer a glimpse of a cherished ideal of the gas industry, namely, the complete conversion of coal into a gas suitable for general distribution. Seventeen years ago, at a meeting of the Institution, gasification with oxygen and steam was visualized as an approach to this problem. Cost of oxygen and unsuitability of composition of the gas offered obstacles then unsurmountable. In the meantime, the oxygen production has been improved and cheapened. High-pressure technique has also shown the possibility of synthesizing hydrocarbons. In Germany, the Lurgi Company has built and operated a high-pressure producer whereby the town of Hirschfelde is supplied with gas made from lignite. In the forty-first report, on experiments made by Dr. F. J. Dent, it is disclosed that solid fuel can be freely hydrogenated to gaseous paraffin hydrocarbons at quite moderate pressures.

After carbonization at low temperatures, a coke contains carbon in a condition very ready to take up hydrogen under pressure, giving gaseous hydrocarbons instead of liquids, but without requiring the very high pressures necessary to 'liquefy' coal. Indeed results quoted show that hydrogenation of the coke combined with gasification of the residue would enable a coal to be converted into a rich gas without exceeding steam boiler pressure, and with an efficiency of 80 per cent. Such a gas, made and purified under pressure, would probably be practically sulphur-free and ready for distribution over considerable distances. Such results would apparently

be attainable with almost any type of coal, whereas high-class coking coal must be used in current practice.

The transference of these results to an industrial scale may take time, but there is no reason to doubt its feasibility as the engineering problems involved have already been solved. There is thus in prospect a method of fuel distribution which should be kept in mind at a time when the future of the coal, fuel and power industries is the subject of repeated inquiry and comment.

The fortieth report, prepared by Mr. J. W. Wood, on the combustion characteristics of town gas, contains a review of the literature on the combustion of gas which is probably the most comprehensive available. It presents an attempt to ascertain the characteristic of a gas most suitable for general use, and is appropriately associated with the forty-first report, which suggests that a process of complete gasification might be capable of adaptation to suit the composition of the gas produced.

A paper on the ignition of gas by 'cold catalyst' by L. W. Androw, A. B. Densham and E. W. Voice suggests that the time is approaching when gas burners may be ignited by the use of a switch only. H. Hollings, W. K. Hutchinson and R. H. Griffith read papers on the removal of sulphur from gas, showing a way to sulphur-free gas made by current methods. Towns gas is the purest commercial fuel—so far as sulphur is concerned—but the removal of the residual traces of sulphur has eluded the ingenuity of gas chemists for generations. Now several alternatives have appeared, and catalytic oxidation of sulphur compounds at 150° holds promise of almost complete removal. When the products of combustion of coal gas are free from sulphur, considerable expansion in the uses of gas can be envisaged, and the reports at this meeting show that this time is now in sight.

H. J. HODSMAN.

Science News a Century Ago

Civil Engineering at the University of Durham

IN the *Civil Engineer and Architect's Journal* for January 1838 is an article entitled "Regulations for Students in Civil Engineering of the University of Durham, passed by the Senate and Convocation, November 22, 1837". In commenting on the Regulations, the *Journal* said: "The engineer, to enter upon any task of magnitude, ought to bring to it natural talents, expanded by education, and strengthened by experience; he ought to combine the mind of the philosopher with the accomplishments of the mechanic; he ought to be a man of profound judgment; he ought to be able to decide not merely what to do, but what *not* to do; . . .

"A large proportion, in fact, the whole of the above-mentioned qualifications so far as education and a rigid academic examination can effect them, will be induced by the system of regulations and course of study prescribed by the Senate; and the practical application of the knowledge obtained at the College will be made most advantageously in the mining districts in the neighbourhood; without the combination of theory with practice, the student when he enters into the world will find himself loaded with a quantity of knowledge which he is more apt to forget than to seek out the opportunity of applying to the advancement of the arts."

Advantages of Medical Botany

AT a meeting of the Medico-Botanical Society on November 22, 1837, reported in the *Lancet* of December 2, Mr. Johnson read a paper on this subject. "The advantages of the study of botany," he said, "were not immediately felt by the majority of medical practitioners, who were satisfied with obtaining their drugs from a wholesale druggist, and such herbs as they might require from Covent Garden. The physician, too, went on his daily practice of prescribing remedies which he had been in the habit of employing for years, and never daring to employ new remedies. This was the cause of the indifference with which medical botany had been treated by the majority of the profession. The objects of the Society were, perhaps, not sufficiently understood; it was not established for the purpose of forwarding the knowledge of botany in the abstract, the locating of certain genera and species, but for the purpose of ascertaining and testing the effects of remedies. Among other reasons why medical practitioners should study botany he might mention that of the present general diffusion of knowledge; many persons studied botany as an amusement, and the medical man, who it was generally considered ought to be better informed than common, should not be behind-hand in this science."

Magnetic Observations in America

AT a meeting of the Royal Society on November 23, 1837, Francis Baily being in the chair, a paper was read entitled "Magnetical Observations made in the West Indies, on the Coasts of Brazil and North America, in the years 1834, 1835, 1836 and 1837". The author was Sir James Everard Home, Bt., Commander, Royal Navy, fellow of the Royal Society, and the observations had been reduced by the Rev. George Fisher, F.R.S.

"The observations of the dip were made with an instrument of modern construction by Dollond.

Each observation consisted of an equal number of readings of the position of the needle, before and after the inversion of its poles, and a mean of all the readings taken for the true dip. Tables are subjoined containing the dips observed at each place; the times of making a hundred vibrations of five horizontal needles, and the mean horizontal forces computed therefrom; and likewise the results estimated in the direction of the dipping needle, compared with direct experiments made with the dipping needle itself."

A Simulated Fast

THE *Lancet* of November 25, 1837, describes the following remarkable case of simulation: "A woman was lately exhibited in Paris as a phenomenon on the ground that she had taken no food for the last twenty months; she was fresh and fat, and carried a healthy child, six months old, at the breast. Not consuming any food the woman could not be supposed to excrete; she accordingly passed no excretion, and the miracle was complete. She carried her folly, or her knavery, so far as even to enter the *Hôtel Dieu* and place herself under the *surveillance* of a physician, M. Caillard, whom she assured that God was the father of her baby, and that he had commanded her to commence a fast in 1836. She was placed in St. Benjamin's Ward, and for several days the history she gave of herself seemed true; the food and drink placed beside the bed had remained intact; no trace of excretion could be discovered. Determined to find an explanation, M. Caillard passed her over to the care of M. Magendie, who happened to have a small closet unoccupied attached to one of his wards. The woman was shut up in this apartment with some food; the quantity of which was accurately measured. She resisted the sense of hunger for eight days, but ate on the ninth. The excretions were found carefully concealed in the mattress, which she had sewn up again."

University Events

BRISTOL.—Dr. Eric Ashby has tendered his resignation from the readership in botany as from December 31, on his appointment to the chair of botany in the University of Sydney.

CAMBRIDGE.—G. L. Clark, of Trinity College, has been elected to an Isaac Newton Studentship.

Dr. C. F. A. Pantin has been appointed reader in invertebrate zoology.

T. T. Paterson, of Trinity College, has been appointed curator of the Museum of Archaeology and of Ethnology.

Dr. J. A. Ramsay, of Queens' College, has been appointed Harding lecturer in experimental zoology. Dr. G. S. Carter, of Corpus Christi College, F. R. Parrington, of Sidney Sussex College, and Dr. G. Salt, of King's College, have been appointed University lecturers in zoology.

LONDON.—Mr. J. D. Bernal has been appointed to the University chair of physics tenable at Birkbeck College. Since 1934 he has been assistant director of research and in charge of the Crystallographic Laboratory at Cambridge.

SHEFFIELD.—The following appointments have been made: H. J. Barrie, as demonstrator in pathology; R. B. M. Jenkins, as assistant lecturer in civil engineering.

Societies and Academies

London

Royal Society, November 11.

F. W. ASTON: A second-order focusing mass spectrograph and isotopic weights by the doublet method. Several improvements have been embodied in this instrument, including adjustable slits and second-order focusing. The instrument has a resolving power of 2,000 and an accuracy of measurement approaching 1 in 10^4 . By its means, a large number of natural doublets have been measured. In many of these, one member is a hydrocarbon molecule, hence the isotopic weight of ^{12}C has been ascertained with particular care. From the results obtained the packing fractions and isotopic weights of more than twenty atomic species are tabulated, some for the first time.

J. E. BEST, F. T. FARMER and J. A. RATCLIFFE: Studies of the E region of the ionosphere.

Paris

Academy of Sciences, October 4 (C.R., 205, 549-584).

HENRI LAGATY and LOUIS MAUME: The chemical determination of the cultivated plant.

ARISTOTLE D. MICHAL: General conformal geometry.

M. and MME. LUCIEN D'AZAMBUJA: Monochromatic images of the sun obtained on the spectroheliograph with the $\lambda 10830$ infra-red helium line, the violet hydrogen line H_ϵ and the infra-red lines of the same element $\lambda 10938$ and $\lambda 10049$.

AUREL NICOLAU: The thermomagnetic study of two paramagnetic solutions. Details of measurements of solutions of nickel sulphate and ferrous ammonium sulphate. Both follow the law of Weiss.

MAURICE FALLOT: The magnetic properties of alloys of iron and rhodium. The results are given graphically. The magnetic properties of these alloys show one remarkable characteristic, the mean atomic moment increases with the percentage of rhodium.

GABRIEL BOSSCHETER and JACQUES ERREBA: Water, as ice, liquid water and in solution in dioxan studied in the near infra-red.

CHARLES DUFRAISSE and JEAN LE BRAS: Combustible substances, regarded as helping incombustible extinguishers, for the practical extinction of flames. Contrary to the usually accepted view, absolute incombustibility is not a necessary condition for fire extinguishers: partially combustible substances or mixtures may be more efficacious provided they do not form a true flame.

PAUL CHOVIN: Researches on Pechmann's colouring matter. The products resulting from the action of alkalis. Mechanism of their formation.

HENRI LONGCHAMON: The genesis of gneiss and granulites with sillimanite in the French Central Massif.

THEODORE V. IONESCU: The calculation of the interval of time between two successive encounters of an electron with the molecules of the ionosphere.

ROGER GAUTHIER: New researches on the culture of cambium tissue. In an earlier communication, the author has shown the possibility of making true cultures of plant tissue. Details are now given of the effects produced by adding small proportions of

heteroauxin, cysteine hydrochloride and vitamin B₁ to the culture media. All these stimulate the proliferation of cambium tissue of *Salix caprea*, cultivated *in vitro*. Of the three substances named, vitamin B₁ gives the best results.

OCTAVE DUBOSCQ, PIERRE P. GRASSE and MAURICE ROSE: The flagella of *Acanthotermes ochraceus* of South Algeria.

BRUNO MINZ and RENÉ AGID: The influence of vitamin B₁ on the activity of acetylcholine.

GEORGES BLANC and MARCEL BALTAZARD: Crossed immunity between the pustular fever and purpura fever of the Rocky Mountains. Vaccination of the guinea pig against these two diseases by a living biliated virus of pustular fever. The immunity conferred by pustular fever against purpura fever is total. It is as strong in man as in laboratory animals.

RENÉ SALQUES: The wool of the osteomalacic sheep.

HENRI EMERY: Immunization of the rabbit against the experimental epithelioma of Brown Pearce.

Cape Town

Royal Society of South Africa, September 15.

A. P. GOOSSENS: A study of the South African species of *Sporobolus* R.Br. with special reference to leaf anatomy. A historical account is given of the work done on the anatomy of grass leaves. The anatomy of the leaves of *Sporobolus* is discussed, and a key to the species is drawn up incorporating these anatomical features. The new species are described and the distribution of all South African species is given.

Moscow

Academy of Sciences, C.R., 15, No. 9, 1937.

J. A. MINDLIN: The boundary dynamic problem of the theory of elasticity for a circle with a given tension.

S. LECHNITSKY: Solution of the problem of elasticity of anisotropic bodies for the interior of an ellipse.

N. MOISEVICH: Periodic trajectories around the point of balancing E_1 in the Copenhagen problem of three bodies.

S. A. BOROVIK and T. T. BOROVIK-ROMANOVA: Variations in the intensity of titanium and vanadium radiation on the introduction into the electric arc of salts of sodium and of potassium.

A. V. STEPANOV: The influence of surface state on the plasticity of crystals.

E. I. GUROVIC: The problem of the presence of films on metals.

W. G. TRONEV: Solubility of noble metals at high pressure (1). The solution of metallic platinum in hydrochloric acid.

G. A. LEVITRAK: Genotypic control of structural chromosome changes.

K. SUCHORUKOV and B. STROGOV: The activators of peroxidase in stork plants.

M. I. GOLDIN: So-called masking of virus diseases.

P. J. SCHMIDT: Two new species of *Artediellus* Jordan from the Okhotsk Sea.

A. M. VASJUTOCKIN: Regeneration of the myoid elements of the thymus gland of amphibians.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 22

UNIVERSITY COLLEGE, LONDON, at 5.30.—The Very Rev. W. R. Inge, K.C.V.O.: "The Price of Progress" (Pickman Godlee Lecture).*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—J. Rymill: Film of the British Graham Land Expedition.

ROYAL SCHOOL OF MINES, at 8.—Prof. B. P. Haigh: "Metallurgy and Mechanics in the Design of Steel Pipes" (Armourers and Brasiers' Company's Lectures. Succeding lectures on November 29 and December 6).*

Tuesday, November 23

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. E. Rubin: "Experience and Perception, Thinking and Feeling" (succeding lectures on November 24 and 26).*

EUGENICS SOCIETY (at the Royal Society, Burlington House, W.1), at 5.30.—J. C. Trevor: "Some Anthropological Considerations of Race Crossing".*

Wednesday, November 24

BRITISH ASSOCIATION (at the Goldsmiths' Hall, Foster Lane, Cheapside, London, E.C.2), at 4.—Dr. R. E. Mortimer Wheeler: "Origins of Town Life in Britain" (Norman Lockyer Lecture).

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at University College, Gower Street, W.C.1), at 8.—Dr. D. J. Lysacht: "Hooke's Theory of Combustion".

Thursday, November 25

ROYAL SOCIETY OF MEDICINE, at 3.—Prof. F. L. Golla: "Science and Psychiatry" (Eighteenth Maudsley Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. G. Stoney, F.R.S.: "Scientific Activities of the late Hon. Sir Charles A. Parsons, O.M., K.C.B., F.R.S." (Parsons Memorial Lecture).

INSTITUTE OF FUEL (at the Junior Institution of Engineers, 39 Victoria Street, S.W.1), at 6.—Symposium on "The Ignition of Fuel on Grates".

Friday, November 26

PHYSICAL SOCIETY (at the London School of Medicine for Women), at 5.15.—Thomas Young Oration.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (at the Royal Society of Arts, John Street, Adelphi, London, W.C.2), at 5.30.—Brigadier M. N. MacLeod: "The Ordnance Survey and its Work".

BEDSON CLUB, KING'S COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Prof. J. R. Partington: "Chemistry in the Ancient World".

ROYAL INSTITUTION, at 9.—Prof. H. Dingle: "Science and the Unobservable".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

SENIOR ENGINEER (short-wave and ultra-short wave systems) and ENGINEER (acoustics) in the Research Department of the B.B.C.—The Engineering Establishment Officer, British Broadcasting Corporation, Broadcasting House, W.1 (November 29).

ASSISTANT LECTURER IN MATHEMATICS in University College, Leicester—The Registrar (November 27).

LECTURER IN PHYSICS in the Leicester College of Technology—The Registrar (November 27).

LECTURER IN GEOGRAPHY AND GEOLOGY in Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (November 27).

LECTURER IN BOTANY (physiology or genetics) in the University of Bristol—The Registrar (December 2).

CHEMIST at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, S.W.7 (December 31).

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 44, Section A, No. 1: Precision Measurements with a Radial Deflection Cathode Ray Oscillograph. By John J. Dowling and Dr. Thomas G. Bullen. Pp. 10+1 plate. 1s. Vol. 44, Section A, No. 2: Some Electrical and Optical Properties of Iodine Vapour. By K. G. Emelius, E. B. Cathcart and C. M. Minnie. Pp. 11-18. Vol. 44, Section A, No. 3: On some Symbolic Formulas in Probability Theory. By T. S. Broderick. Pp. 19-28. 1s. Vol. 44, Section A, No. 4: The Zeros of Legendre Functions. By Dr. P. G. Gormley. Pp. 29-43. 1s. Vol. 44, Section B, No. 1: The Influence of Temperature on the Activity of the Kidney in relation to its Influence on Oxygen Consumption. By E. J. Conway, J. M. O'Connor and D. K. O'Donovan. Pp. 18. 1s. Vol. 44, Section B, No. 2: Structural Laws of the Mammalian Kidney, with a Theoretical Derivation from a Diffusion-Pressure Theory. By E. J. Conway. Pp. 19-28. 1s. Vol. 44, Section B, No. 3: A Map of the Glacier-Lakes and the Local Glaciers of the Wicklow Hills. By Prof. J. K. Charlesworth. Pp. 29-38+plate 2. 1s. Vol. 44, Section B, No. 4: Studies in the Synthesis of Flavonols—The Oxidation of Flavonodigenins. By Dr. Joseph Algar and Isabella P. Carey. Pp. 37-44. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [311]

Other Countries

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines, Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), July to December 1936. (No. 778.) Pp. iii+204. (Ottawa: King's Printer.) [3010]

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 6, No. 6: Lufthållanden vid Sveriges Kuster under Vintern 1870-71—1934-35. Av C. J. Östman. Pp. 63+2 plates. 3.00 kr. Band 7, No. 1: Fyriska. Av Ragnar Malm. Pp. 15+1 plate. 1.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [111]

Cornell University: Agricultural Experiment Station. Bulletin 673: Economic Studies of Vegetable Farming in New York. 2: Market-Garden Farms without Greenhouses, Rochester Area. By J. L. Paschal. Pp. 86. Bulletin 676: Tomato Fertilizer Experiments on Long Island. By J. D. Hartman, Paul Work and P. H. Wessels. Pp. 12. Memoir 199: Index Numbers of the Cost of Goods and Services bought by Farm Families in New York, 1929 to 1935. By Helen Canon and Mabel Bollins. Pp. 23. Memoir 200: Relation of Size of Community to Marital Status. By Dwight Sanderson. Pp. 74. Memoir 201: The Daily Rate of Photosynthesis, during the Growing Season of 1935, of a Young Apple Tree of Bearing Age. By A. J. Heinicke and N. P. Childers. Pp. 52. Memoir 202: Quantitative Determination of Lactic Acid in Butter. By H. C. Troy and Paul F. Sharp. Pp. 17. Memoir 203: Incidence of Fire Blight in Young Apple Trees in relation to Orchard Practices. By R. M. Hildebrand and A. J. Heinicke. Pp. 38. Memoir 204: The Reliability of Flavor Judgments, with Special Reference to the Oxidized Flavor of Milk. By G. Malcolm Trout and Paul F. Sharp. Pp. 60. (Ithaca, N.Y.: Cornell University.) [111]

II^e Congrès Scientifique International de l'Alimentation organisé par la Société Scientifique d'Hygiène Alimentaire. La Science de l'Alimentation en 1937. Pp. A121+B72+C163+D73+E53+F90+iv. (Paris: Congrès Scientifique International de l'Alimentation.) [111]

Bulletin of the American Museum of Natural History. Vol. 74, Art. 1: New Fishes from the Continental Tertiary of Alaska. By Erich M. Schlaikjer. Pp. 26. (New York: American Museum of Natural History.) [311]

Catalogues, etc.

Allgemeine und angewandte Zoologie. (Antiquariate-Katalog Nr. 715.) Pp. 160. (Leipzig: Gustav Fock, G.m.b.H.)

Marmite (Yeast Extract) in Medicine and Dietetics. Pp. 24. (London: The Marmite Food Extract Co., Ltd.)

Books on Botany, Part 2. (New Series, Catalogue No. 46.) Pp. 44. (London: Wheldon and Wesley, Ltd.)

The Lovibond Comparator for Colorimetric Determinations. Pp. 26. (Milford, Salisbury: The Tintometer, Ltd.)

Vermeer. (Catalogue No. 28.) Pp. 68. (Den Haag: Antiquariaat W. Junk.)

The Dextrac Industrial X-Ray Unit. (Publication No. 257.) Pp. 9. The Spekker Minor Ultra-Violet Photometer. (S.B. 258.) Pp. 4. (London: Adam Hilger, Ltd.)

A Catalogue of Books Old and Modern, comprising Recent Second-hand Purchases, including Works on the Alps and Montmarins: Architecture, Art, Topography, etc. (No. 485.) Pp. 20. (Cambridge: Howes and Howes.)

"Cresall" Dinning Resistance. (List No. 87.) Pp. 2. "Cresall" Electric Branding Iron. (Leaflet No. 66.) Pp. 2. (Birmingham: The Cresall Manufacturing Co., Ltd.)

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3552

SATURDAY, NOVEMBER 27, 1937

Vol. 140

Defence and Economic Adjustment

THE recent debate in the House of Commons on the second reading of the Air Raid Precautions Bill brought into clear prominence the close contact between the work of chemists and other men of science and protection from its devastating consequences under the conditions of modern warfare. Mr. G. Lloyd, Under-Secretary of the Home Office, made a comprehensive survey of the measures taken by the Government, and in course of development, to provide the civilian population with whatever means of defence is practicable against effects of air raids. The object of his Department is to make the community as a whole, as well as individual citizens, aware of the dangers of high explosives, toxic gases and incendiary bombs set free from enemy aircraft, and to institute reasonable precautionary measures against them. Possibly some of these anticipated dangers are exaggerated, especially that from gas, but it would be folly to disregard them; but for psychological reasons the people of the country must be given a certain amount of confidence in protective measures in order to prevent them from becoming panic-stricken. Even although it is sometimes difficult to distinguish between the necessity of expenditure upon increased armaments and that of defence programmes, it is in the interest of everyone that whatever precautionary measures are planned or contemplated should be as efficient as science can make them.

The attitude which chemists and other scientific workers should take in regard to the manufacture of munitions of war has been discussed on many occasions, but opinions upon it vary as much among them as they do among citizens in general. The suggestion put before the Technical Committee of the Disarmament Conference that the

chemists of the world should include in their code of ethics an undertaking not to work knowingly on the development and production of any prohibited method of warfare, and to expose publicly anyone who was detected in such work, is altogether impracticable. Chemists are citizens as well as men of science, and their services should, therefore, be available for what is regarded as the good of the community. At all stages of human history men have used for purposes of war the most effective means of destruction known to them; and there is little difference in principle in the employment of Greek fire many centuries ago and the use of incendiary bombs to-day. Even in those days boiling oil and molten lead were used as measures of defence against attacks on the walls of cities as well as of fortresses.

The scientific worker cannot stand apart, therefore, from reasonable and practicable steps taken towards the protection of the civil population from aerial attacks. He, with many others, may deplore the loss of his faith in the progressive ethical development of the human race, but his natural humanity must make him play his part in endeavours to prevent suffering and death.

While, however, we in Great Britain are planning and undertaking a defence programme which will cost many millions of pounds, it should not be forgotten that France, Germany and other nations have instituted similar protective measures against aerial attacks by other nations—ourselves included. As it may be assumed that most people wish to carry on their work in peace and to promote the industry and commerce of their country, such a condition of things is a reproach to human intelligence. It represents the acceptance of a

policy of despair of avoiding war instead of attempting to discover the causes which lead to armed conflict. Fortunately, efforts are being made in several quarters to promote inquiries into such causes before appeals are made to force. In a petition presented by a deputation to the Prime Minister on November 1, it was urged that H.M. Government should take the initiative in instituting an inquiry into the fundamental causes of rivalry and unrest among nations. More than one hundred fellows of the Royal Society were among the influential signatories of this petition. They, in common with many other distinguished representatives of other fields of intellectual activity, are horrified at the barbaric ways in which progressive scientific knowledge is permitted to be used in operations of war, and associate themselves with any action which may assist in preventing such calamities.

It was suggested by the petitioners that the inquiry might involve the collection and consideration of the basic facts in regard to such questions as access to war materials and world markets, colonial development, problems of surplus populations, and so on, which are often discussed without adequate knowledge and judged without evidence. Though some countries may decline to participate in such an inquiry, or be influenced by the results, it would represent a search for some means of reconciling conflicting national claims and thus make manifest the desire to promote peace on a secure and just foundation. In his speech at the Lord Mayor's banquet on November 9, and again in an address at Edinburgh three days later, the Prime Minister expressed his active interest in efforts of this kind to inquire into the origin and substance of the fears and suspicions which exist among nations, with the view of removing them. "Our country," he said, "has behind her vast, almost illimitable resources, and our very strength makes it easier for us to appeal to others to join in applying our common-sense, our common humanity, to the solution of those problems which carry with them such tremendous possibility for happiness or for misery to the future of the human race. I have faith in human nature. Because I have that faith I believe there will be a ready response to such an appeal."

The economic commission suggested by King Leopold of the Belgians a few months ago would have the same objects as those to which the Prime Minister referred. At the Guildhall on November 17, responding to the toast proposed by the Lord

Mayor of London, King Leopold expressed the hope that Great Britain would take a prominent part in inquiring into the economic difficulties which lie at the root of the international problems which beset the world. "In order to solve those difficulties," he said, "we should need to get a clear view of economic realities seen with a dispassionate eye and divorced from every other consideration. The British Empire represents so important a part of the human race that it cannot help but realize more clearly than any other nation how closely the fate of mankind is bound up with its own. That is why your understanding of the great universal problems is so profound and why it is permissible to be hopeful that Great Britain may play a prominent part in the search for a solution of the major economic difficulties." Questioned upon the subject of this appeal in the House of Commons on Monday, the Prime Minister said that he was glad to have an opportunity of responding cordially to it on behalf of the Government, which, he said, are "fully prepared to play their part in the search for a solution of the world's major economic difficulties".

The Anglo-American trade agreement, which, after months of informal conversations, has now reached a stage at which, as announced by the Prime Minister in the House of Commons on November 18, definite steps can be taken towards actual negotiation of terms, is an example of what can be done by the joint discussion of national problems; and its political implications are as important as its economic interests. It is by the application of scientific methods and of the scientific spirit in these fields that there is hope of discovering the causes, and averting the consequences, of international disputes. Though the impartial and responsible study of some of the international economic and racial problems of to-day may not satisfy some national claims, it would in any event make the civilized world understand whether or no national passions had been aroused in a just cause. Instead of waiting for war and at the end of hostilities inquiring into the causes which led to it, and adjusting the consequences in the bitterness of spirit which must then prevail, let us urge that every opportunity should be taken to promote full and frank inquiries into economic or other restrictions or grievances, so that a certain amount of attention may be diverted from preparation for offence or defence in war to the discovery of the conditions of creative peace.

Science in Psychology

Psychology down the Ages

By Prof. C. Spearman. Vol. 1. Pp. xi + 454. Vol. 2. Pp. vii + 355. 8vo. (London: Macmillan and Co., Ltd., 1937.) Two vols., 30s. net.

ABOUT the beginning of the present century, psychology began to emerge from the kind of chrysalis state in which it was lying dormant and cramped in the cocoon of associationism, and to become a natural science. Even so lately as 1890 no less a psychologist than William James, who made a valiant attempt to break away from the fetters of the system in which he had been trained, brought his "Principles" to an end with the words: "Even in the clearest parts of psychology our insight is insignificant enough. And the more sincerely one seeks to trace the actual course of *psychogenesis* . . . the more clearly one perceives 'the slowly gathering twilight close in utter night'." Not only here did he strike the same pessimistic note. In his "Briefer Course" he concludes in the same strain: ". . . not a single law in the sense in which physics shows us laws, not a single proposition from which consequences can causally be deduced. . . . This is no science, it is only the hope of a science". What a confession to be obliged to make!

But some ten or fifteen years after those words were written by one of the then greatest living psychologists, there came a stirring into life of the apparently dead, and certainly quiescent, pupa. I say pupa, but there must have been more than one of these; for no fewer than six important systems of psychology sprang into being at about the same time, all of them (save one) showing signs of a profound metamorphosis. Of these, in this notice, we are concerned with that of Charles Spearman, whose psychological principles and theories are now probably better known and more highly appreciated in the academic world than those of any other contemporary psychologist. This was not so when Spearman first published the results of his researches into the nature of intelligence. It was not so when, in a series of papers dating from 1904, he gave forth his mathematical conclusions as to the joint operation of two factors in every cognitive activity. At first there was much dissention and criticism. But all this has now for the most part subsided; and the most trenchant of the erstwhile critics have adopted his mathematical treatment of psychological data, and are busily extending it to cover temperamental and character qualities as well as

cognitive ones. Moreover, the noegenetic (knowledge originating) principles of the apprehension of experience, the finding of relations within apprehended experience, and the extension of knowledge even beyond experience, so obviously account for the observed facts that, like Newton's laws of movement, they can scarcely be gainsaid. Some critics have objected that these principles are logical rather than psychological; but a like criticism might as well be urged against Newton's laws. They also are logical; if they were not they could scarcely be rational, or in any sense explanatory.

Apart from his contributions to psychological, educational, statistical and other journals, Spearman has published two outstanding, and even, as a former reviewer called one of them, "epoch-making" works ("The Nature of Intelligence and the Principles of Cognition", 1923; "The Abilities of Man", 1927). In these he developed his own theories, and substantiated them by the results of a large number of researches carried out under his direction by his numerous students in the laboratory of University College, London, as well as by those of many other investigators elsewhere. The researches he himself directed clearly were governed from the outset by a definite plan. They all converge upon the problem he had originally set himself, namely, to discover what it is that makes for ability in mental effort. In these two volumes he expanded and developed the qualitative laws of noegenesis, together with the quantitative laws of mental energy, retentivity, fatigue, control, and the basic conditions of all mentation. By means of these two sets of laws, he claims, it is possible to account for every sort of knowing, whether original or subsequential. In these works also he gave convincing evidence for the "Two Factor" theory, which requires the co-operation of a general and common factor that is involved in every mental operation, together with special factors that are restricted to each different kind of cognitive process. But in them he did not especially show the immense acquaintance with psychological literature, ancient, medieval and modern, which must have been in the background of his mind throughout. In "Psychology down the Ages" this becomes apparent. Nor did he in the previous works more than lightly touch upon the "orectic" side of the mind. In the present work, this is much more amply treated, especially with regard to volition, emotion and psychological types of character and temperament.

In a sense the present two volumes should have been the first to appear. They do not constitute a history of psychology in the usual meaning of the word; but they show how psychology has advanced from the primitive conceptions of the animists, through the ruminations of the philosophers, to win the status of an empirical science. They show, too, how much has been forgotten and rediscovered, how many mistakes have been made, and how, despite them, psychology has advanced like a slowly flowing tide. To change the metaphor, as Spearman writes in his prologue, "we hope to indicate the chief assets, as also liabilities, which have been accumulated, and so to draw up a fair and square balance sheet". This aim he has certainly accomplished.

Beginning with a section which deals with the subject-matter and scope of the science, Spearman next examines the operations and constitution of what he, disregarding the misleading (because theologically and metaphysically contaminated) terms like 'soul', 'mind' and 'consciousness', calls the 'psyche', and goes on to the establishment of genuine psychological laws (sequences) which, like any other scientific laws, explain the data to be explained, and also, when known and applied, permit of both the prediction and the control of events.

The final section of the work deals with concomitances: 'What goes with what?' This is a matter of statistical evidence; and here the old 'faculty doctrine' is put upon its right footing. It cannot be assumed that, because a name, like 'memory', 'sense' or 'intellect', is given to a

presumably unitary, psychological function, such a function is in fact unitary. Indeed, experiment has shown that there are different kinds of 'memories'; and it is obvious that one cannot infer an acuity of one sense from the acuity of another. One may have an excellent sense of touch and a very poor one of hearing, or an exquisite appreciation of odours, and yet be totally colour-blind. These faculty 'concomitances' have to be proved, not assumed; and the only way of proving or disproving them is that of correlation. It is perhaps Spearman's chief achievement that he has forced psychologists to recognize this. Piling up introspective or observational data with no instrument for dealing with them is a thankless task, and leads nowhere in science. For centuries people have made introspections (to say "I am angry, or hot, or interested" is to report the result of an introspection); but no laws have resulted from them alone. Treating data, the significance of which is not known, statistically, may yield coefficients of correlation but by itself is meaningless and nonsensical. It is only the marriage of these two methods that yields a legitimate and healthy offspring, in the shape of principles or laws.

"Psychology down the Ages" is an eminently sane, judicious and scientifically balanced work, easy to read and understand, and (to borrow the words of a reviewer of a former work of Spearman and apply them to this) the "most distinguished British contribution to experimental psychology that has been made in recent years". Indeed, both in comprehensiveness and clarity, it excels "The Abilities of Man". F. AVELING.

Intermediate Chemistry

Intermediate Chemistry

By Prof. T. M. Lowry and A. C. Cavell. Pp. xvi + 880. (London: Macmillan and Co., Ltd., 1936.) 12s. 6d.

AS the title indicates, this book is written expressly for the student preparing for an Intermediate examination in chemistry, and it should fulfil its purpose excellently.

It is comprehensive within its field, and so, after the usual general theory and descriptive inorganic chemistry have been dealt with, very faithfully, in the first half of the text, there follow three further sections dealing respectively with analysis, with physical chemistry and with the broad principles of organic chemistry. Thus, within one cover (which, with typical thoughtfulness and good sense, is made waterproof) we have assembled

all that the Intermediate student requires—the equivalent of three or four other books. It is remarkably good value for money.

Good value, too, in quality: every section gives a precise and remarkably full account of its subject from a thoroughly modern point of view. Indeed the one possible adverse criticism seems to be that the matter given, especially perhaps in the physical part, is needlessly extensive and more than the average first-year student can assimilate. Such criticism, however, would be unsound: it is surely desirable, even though a young student cannot be expected to remember all that is here, that the residue which does stick, whatever general sense of chemistry he gains, should be derived from reading an account of chemistry which takes a properly generous view of his intellect and interest.

The authors have adopted the very sound view that it is the teacher's job to make chemistry alluring and theirs to write a plain, unvarnished tale, with every fact and argument so clearly delineated that the apt student may discover for himself the beauty of the science. It is not least among the many merits of this book that from its concise, plain English, delightfully free from any looseness or ambiguity of thought or statement, he will learn more than chemistry.

There are so many features one would like to commend in detail, for example, the chapters on the structure of matter and the electronic theory of valency, or the large and useful collection of questions at the end (with answers), that it is impossible in a brief review to deal with the book in this way. It must suffice to say that it should be possessed and studied by every serious student or teacher of chemistry.

H. V. A. BRISCOE.

That Leviathan

Giant Fishes, Whales and Dolphins

By J. R. Norman and F. C. Fraser. Pp. xxviii + 361 + 8 plates. (London and New York: Putnam and Co., Ltd., 1937.) 15s. net.

"NOW the Lord had prepared a great fish to swallow up Jonah." The interminable debate goes on among dabblers in textual criticism as to whether it was a whale or a fish that engulfed the prophet. At best the discussion has been scientifically of a low order, but there is no longer any excuse for vagueness now that J. R. Norman and Dr. F. C. Fraser have gathered all the possibilities (barring those of special creation) into one compact volume.

Here are assembled under one roof, so to speak, all the great denizens of the sea, both fish and whale, together with their respective dependants and victims. A concise introduction elucidates the chief points of difference between fishes and whales. Their comparative anatomy, modes of reproduction and habits are described. Fortunately, this section is short enough to enable inquirers to find what they want by reading through the text, since the indexing of this section, in Roman numerals, leaves much to be desired.

Then follows Norman's account of the giant fishes, beginning properly with the most ancient order, Selachians, among which are to be found the most savage and bulky fishes. Sharks and rays are clearly described and differentiated. Their distribution, breeding habits, and relative voracities are touched upon, usefully dispelling the prevalent notion that all sharks are ferocious man-eaters. The author recalls that the reward of 500 dollars offered for an authentic case of a man having been attacked by a shark in temperate waters was never claimed. The description of seventeen different sharks is agreeably leavened by anecdotes of their rapacity and catholic appetites. Tenacity of life is theirs to a high degree, as witness the Blue shark which was caught, gutted, and returned to

the sea, only to be recaptured on a hook baited with its own intestines; while the Great White shark that turned King's evidence, yielding on capture the incriminating log-book of an American privateer, may perhaps be awarded the palm for unwitting loyalty to Britannia.

All the great fishes and some of the small ones are described, and some of the largest recorded catches are mentioned, together with much other piscatorial anecdote. Flying fishes have been wisely included, since they are so often seen by travellers; the gliding nature of their flight is emphasized. A simple key to the large fish concludes this section.

Both sections of the book are profusely illustrated with drawings, and there are eight coloured plates of great beauty. Lieut.-Colonel Tenison's scrupulous illustrations greatly enhance the value of the book, particularly for non-scientific readers, who by referring to them should be able to identify both fish and whale easily.

Fraser's contribution on whales and porpoises is of the same high standard, and similarly enriched by narrative. Every whale that the traveller is likely to see is fully described and depicted. There is also a key to this section. A concise history is given of the exploitation of the remunerative species of whales. This story of virtual extermination of one species after another makes sorry reading, but it is particularly apposite at the present time, when the rorqual fisheries of the Antarctic are invaded yearly by huge fleets of highly equipped whale catchers. The author has omitted to point out that there are clear indications that the stock of Blue whales is already greatly diminished. With the decline of Blue whales, the burden of slaughter is falling more and more on Fin whales, of which 12,500 were killed in 1935-36. When the latter also shall have become too scarce to be profitably hunted, the last chapter will have been written in a history of brutal and wanton

exploitation. Other breeds of whales have not in the past had the advantage of scientific investigation; with the statistics which are now available, whalers cannot plead ignorance as they kill the goose that lays the golden egg.

The book is well printed on good paper. The

beginning and end of most chapters are embellished with witty line-drawings. Here is an unusual blend of liveliness and scientific accuracy, which should find a place in ships' libraries and on the shelves of all interested in the creatures of the deep.

A. H. L.

A Catechism of Evolution

Evolution and its Modern Critics

By Dr. A. Morley Davies. Pp. xii + 277. (London: Thomas Murby and Co., 1937.) 7s. 6d. net.

BY evolution we understand that integration and combination of originally homogeneous atoms which has produced our world and its contents. These are governed mainly by physical forces, which are as yet little understood but which represent the governance of the universe. There may in our minds be other thoughts, even certainties, with which we have no quarrel; but these should scarcely be allowed to affect the consideration as to the combinations by which life was originally produced and as to how that life was moulded to give the varied series of organisms we find to-day. It is infinitely more difficult to imagine the production of living matter with its functional reactions to the world around it, than to consider if it evolved afterwards, and the driving forces which caused this evolution. Conversely, if evolution to produce the present organic world be proved, utilizing only natural forces, there is a strong presumption that such forces gave rise to life.

It is with thoughts such as these, here imagined for Dr. Morley Davies, that a start is made on an attempt to prove the adequacy of the evolution theory to explain the diversities of the organic world. In this there is never dullness, for there is originality in both treatment and thought. A good instance is in the chapter devoted to the palæontological record, wherein is patiently explained the exact position in respect to the remains of the organisms of past ages, the impossibility that they shall at present provide any record approaching that completeness for which the student so frequently inquires. Instead of a hypothetical discussion, the author takes Mr. Douglas Dewar's 'Difficulties of the Evolution Theory' in place of a young student's questions, this reinforced by the late G. K. Chesterton's journalism. The student proceeds on his appointed courses from the simple to the complex, but Mr. Dewar apparently has reversed, birds having been his love. We wonder whether he understands the basal phenomena of

living matter and the essential functioning of every part of an animal's body with its environment. Quotations from his book in Dr. Davies's chapter on "Reptiles and Birds" suggest this question and he certainly does not understand an animal's fate after death, almost a miracle if its body does not provide nutriment on which the next generation grows. In this connexion a search in the writer's garden produced several hundred clay pipes, but associated with them no recognizable bones other than those of the ox—this he can readily understand, for his dogs allow no other mammalian remains to be recognizable for long. Then too these varied quotations suggest to us that Mr. Dewar considers evolution to have been an infinitely slow process, whereas modern research, especially cytological, suggests a speed in changes which would only by rare accident allow of the preservation of intermediate stages in fossil form. Dr. Davies can scarcely allow Mr. Dewar's idea "of evolution within the family but not beyond it", since there is no understanding among systematists as to the practical definition of "family"; the unit in evolution is the individual, and, if it can change, the question of genera, families and even phyla scarcely needs discussion.

We are always interested in W. R. Thompson's thoughts here quoted; to us he seems to be rather unnecessarily dragged in here. It is otherwise with Sir Ambrose Fleming, of high distinction in the domain of electrical engineering, who in what is in many ways a mischievous lecture dealt with a subject with which he was unfamiliar. He wrote of "Darwinian evolution" requiring a high birth-rate and a low death-rate whereas it requires "a high but selective death-rate". Then there followed Sir Ambrose's attack on the validity of palæontological evidence in respect to man, for which little is claimed—pathetic because there is so little understanding as to what is evidence in scientific and in historical research. The reply here is adequate—and we recommend this little book as likely to be useful to the public as well as to professional teachers and students of science.

J. S. G.

Rock Magmas and their Products

Das Magma und seine Produkte:

unter besonderer Berücksichtigung des Einflusses der leichtflüchtigen Bestandteile. Zugleich zweite Auflage des Buches "Die leichtflüchtigen Bestandteile im Magma". Teil 1: Physikalisch-chemische Grundlagen. Von Prof. Paul Niggli. Pp. xi + 379. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 34 gold marks.

THE solid igneous rocks are the products of colossal natural processes working unceasingly within and upon the crust of the earth. The study of these phenomena forms the special province of the petrologist, who attempts to discover the manner in which an original silicate melt—the magma—becomes differentiated into the varied mineral assemblages he finds in Nature.

For more than thirty years the chief project of research of the workers of the Geophysical Laboratory of the Carnegie Institution at Washington has been the experimental investigation on quantitative lines of chemical systems embracing the common rock-forming oxides. Starting with the simplest combinations and proceeding to more complex systems, these investigators have gradually accumulated a wealth of data of fundamental importance to petrology. To this project Prof. Niggli has himself given experimental support, and he is well qualified to survey the experimental studies and the contribution they make to the problems of petrogenesis.

The present book, forming Part 1 of a two-volume treatise on rock magmas and their products, concerns itself with the physical chemistry of heterogeneous and homogeneous systems with special reference to experimental silicate melts. The succeeding volume will be devoted to a consideration of the phenomena of natural systems—magmatic melts and their solidified products, the igneous rocks and ore deposits.

The book opens with a historical account of the development of ideas on the role of volatile substances in the magma. There follow chapters of pure physical chemistry presenting a systematic account of phase equilibria in condensed heterogeneous systems, special attention being paid to the phenomena of petrological significance displayed by ternary silicate melts. The majority of such experimentally investigated systems is included in this survey, which gives a clear account of the alternative courses of crystallization permitted by continuous and discontinuous reactions which may prevail in ternary silicate solutions.

Some criticism may here be made of the method of presentation adopted for ternary melts. In order

to trace readily the changing composition of a residual liquid in terms of a specialized variation diagram, and presumably in preparation for more extended discussion in volume 2, the author redraws the ternary figures on a molecular per cent basis. These transformations involve considerable complication when the fundamental phases are themselves complex silicate compounds. It may well be doubted whether so cumbersome an innovation will make appeal to petrologists who have still to discover the superior convenience of the 'Niggli type' of variation diagram for which this procedure is more peculiarly fitted.

In the second half of the book, Prof. Niggli enters upon a discussion of heterogeneous equilibrium in systems containing volatile phases—a subject to which the author has himself made important original contributions. The treatment follows closely the text of his earlier published work—of which this part may be considered a revision.

Equilibria in binary and ternary mixtures involving retrograde boiling and critical phenomena in saturated solutions are thoroughly discussed. Since the experimental data on ternary silicate systems involving water comprise only those of the complex $H_2O-K_2SiO_3-SiO_2$, the importance of critical phenomena in magmatic systems has yet to be assessed. While the critical state is assigned a more important place in the history of the cooling magma than is usually conceded, the author's renewed discussion of volatile systems is a welcome contribution serving to remove from the field of contention misunderstandings which have followed the publication of his earlier work.

This account is followed by a chapter on homogeneous equilibria in silicate melts. This is a subject of great importance, but unfortunately our knowledge of it is meagre and largely confined to deductions that may be drawn from the behaviour of heterogeneous systems. Here the author rightly lays emphasis more especially on the influence of volatile constituents in modifying the chemical as well as the physical condition of the magmatic melt.

The book closes with an ingenious portrayal in ternary diagrams—admittedly schematic and immensely simplified—of the differentiation course of a typical Atlantic and Pacific rock province. Presented here without elaboration, it is presumably a signal of a more detailed treatment in the concluding volume. Comment upon it may well be deferred. The high reputation of the author is a guarantee that a stimulating and fruitful discussion of these problems is to follow.

C. E. TILLEY.

Overseas Plant Products

By J. H. Holland. Pp. vii+279. (London: John Bale, Sons and Curnow, Ltd., 1937.) 6s. net.

THE author has very ably dealt in 268 pages with nearly all the important plant products of the world. Short explanatory notes to each of the products mentioned are authentic, accurate and up to date. Eleven pages of bibliography at the end of the book is a valuable addition. Those interested in further information on any one of the products discussed in the book can consult the particular literature relating to that product. Common vernacular names used generally in different countries might have been added for the advantage of local dealers in plant products. Short notes on the marketing of those products would also have been encouraging to the producers. With the progress of research on various plant products, and the discovery of the uses of many hitherto unknown plants in different countries, particularly in India, Burma and Africa, the list of plant products is growing so rapidly that it is to be hoped a second edition will be quickly necessary; slight discrepancies in some places might then be rectified also.

The book is a valuable addition to the publications on economic botany. It will undoubtedly prove useful not only to those who deal in plant products, but also to anyone interested in the relation of plants to human needs. It will be indispensable to museum workers, economic botanists and pharmacologists. The book is well printed and bound.

Materialprüfung mit Röntgenstrahlen:

unter besonderer Berücksichtigung der Röntgenmetallkunde. Von Prof. Dr. Richard Glocker. Zweite umgearbeitete Auflage. Pp. v+386. (Berlin: Julius Springer, 1936.) 33 gold marks.

SINCE the appearance of the first edition of this well-known work in 1927, the use of X-rays in the examination of materials has been greatly extended. The new edition is similar to the old in general arrangement, and any considerable increase in size has been avoided by careful revision of each section. The description of X-ray outfits (of German manufacture), now includes a full account of portable apparatus for the detection of flaws in built-up structures as well as the laboratory types, and the methods used in the examination of castings, forgings and welds are described. The discussion of determination of crystal structures, which occupies the greater part of the book, is both clear and informative. Tables of important structures are given, including a survey of the principal alloy systems, and such subjects as deformation textures and the determination of internal stress are treated in detail, although British work in this field has been overlooked. The section on transformations in the solid state also suffers through being too closely confined to German investigations, but the general presentation is fair, and the book can be recommended as a sound guide to a very important method of experiment. The mathematical treatment is simple and straightforward, and references to the more important papers under each head are collected in the bibliography.

Quantitative Analysis:

a Theoretical Approach. By Prof. William Rieman, III., and Dr. Jacob D. Neuss. (International Chemical Series.) Pp. ix+425. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18s.

THIS is a most satisfactory text-book for the student. It is up to date, the theoretical principles underlying the various methods are clearly and accurately stated and the conditions for carrying out individual exercises are given in ample detail. To each chapter there is a useful résumé in the form of graded problems, and answers are provided to the numerical ones.

To deal with the theory and technique of potentiometric methods immediately following the volumetric determination of the chlorine ion and before discussing the methods of acidimetry and alkalimetry will be novel to many teachers. Its treatment could scarcely be better, although the authors have to assume a knowledge of mathematics unfortunately not possessed by all students who can profitably work through such a book as this.

No modern method of volumetric or gravimetric analysis with which the student might be expected to be familiar seems to have been omitted. Apart from anything else, the references to original and text-book literature will indicate to the student that quantitative chemical analysis is an important and continually expanding branch of chemical science.

C. S. G.

The Social Thought of the Ancient Civilizations

By Prof. Joyce O. Hertzler. (McGraw-Hill Publications in Sociology.) Pp. xvi+409. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 24s.

NO one would dispute the desirability of the possibility of an examination of the social thought of the ancient civilizations, especially after reading the very able book of Prof. Hertzler. It is not only history, but also sociology and philosophy which can benefit from such an examination. For social forms of civilizations are necessarily an embodiment of the thought and attitude towards life of the various races concerned. The systematic exposition of the social thought of the ancient Egyptians, then of the Babylonians with special emphasis upon the Assyrian and Hittite collections of laws, then of ancient Persia, of early India and of ancient China, and finally of the Hebrews, is illustrated with a wealth of quotations from all available sources. The discussion of the principles involved is based also on the general background of the races concerned. The author has taken great trouble in selecting his material and in classifying it in such a way as to provide an intelligible and interesting study of the subject.

G. T.

Wireless Servicing Manual

By W. T. Cocking. Third (revised) edition. Pp. x+241. (London: Iliffe and Sons, Ltd., n.d.) 5s. net.

A VERY useful and reasonably priced monograph on the pathology of the wireless receiver, which can be recommended as supplementary reading to the usual text-books.

A Century of Geological Investigation

A CONNECTED history of the work of the Geological Survey of Great Britain has long been overdue. It is true that many details can be gathered from the lives of Edward Forbes, Murchison and Ramsay, from Geikie's "Long Life's Work", and from the registers of the Royal School of Mines and the Royal College of Science. But what was wanted was an impersonal account of the service and its work, written from the point of view of the service itself; and that has now been furnished by Sir John Flett in "The First Hundred Years of the Geological Survey of Great Britain"*. It was the last act of his thirty-five years' service, during fifteen of which he was director, and for another ten assistant to the director for Scotland. It marks the centenary in 1935 of the Survey, and the opening of the new Geological Museum at Kensington by H.R.H. the Duke of York, now His Majesty King George VI.

The author has succeeded in making a clear statement of the complicated history of the Survey itself, and the other institutions now or formerly a part of it or very closely associated with it. He directs attention to the demand for such an institution on the part of the mineral industries of the country and the influence of famous geologists and of the Geological Society, which caused the idea of a State survey to be accepted and even welcomed by the authorities of the time. He has indicated in due proportion the share in the mapping and description of the country taken by the leading geologists of the Surveys. And he has enabled the reader to form a fair judgment on the progress effected as a result of royal commissions and committees of inquiry, and by the successive directors in the favourable or unfavourable conditions prevailing during their periods of office.

It is impossible to speak too highly of the work and influence of the first director-general, Sir Henry De la Beche, appointed in 1835, after he had offered, at trifling cost, to "affix geological colours" to the new maps of Devon and Cornwall about to be issued by the Ordnance Survey. He set himself to do four things which he considered to be essential at the time, and which he saw could be carried out, at first at any rate, by a State Survey as he conceived it: (1) The mapping and description of the geology of the country, especially in relation to its mineral resources; (2) the collection and preservation in some accessible

place of the evidence on which such work is founded, the records of the work as it advanced, the literature necessary for proper working up of the material, and specimens to illustrate the geology and mineral resources; (3) the education and training of men capable of doing the work or of directing the development of the mining industries; (4) the collection and preservation of mining statistics and records, especially so far as they are necessary to guide future exploitation. The first two objects have remained and grown as the special care of the Survey; the other two sooner or later budded off and are now living separate and vigorous lives of their own.

It being essential first to acquire an exact knowledge of the ground-work, the geological nature and structure of the land, attention was concentrated on mapping, with a remarkable team which grew steadily in strength. The director himself and his assistants, among whom Aveline, Ramsay, Jukes, Logan and Selwyn were leaders, worked at high speed and with an accuracy which is wonderful when it is considered that only one-inch maps, uncountoured and often unsatisfactory in topography, were all that were available for either field-work or publication. Maps were supplemented by 'horizontal' sections (illustrated by explanations) along specially surveyed routes, and by 'vertical' sections on a large scale giving full detail of thoroughly explored ground. More maps and sections were published under this régime than at any later time. Little leisure, however, was left for writing, and few memoirs were published, those put out being mainly essays on scientific subjects, or descriptions of considerable regions, such as the South Staffordshire coalfield by Jukes.

A museum was opened at Craig's Court in 1841, but ten years later the Prince Consort opened its successor, the Museum of Practical Geology at Jermyn Street, where the collections and workers were housed for eighty years. This "was the first important building in Great Britain designed to be occupied by the staff of a purely scientific institution". The Museum was intended to be definitely national, economic and practical, and in time these objects came to overshadow the scientific side, for example, in the large and valuable collections of metal work and pottery. For these, new and more appropriate sites were found soon after 1901, and room was thus provided for the more direct applications of geology. A distinguished staff was employed in the Museum

* The First Hundred Years of the Geological Survey of Great Britain. By Sir John Smith Flett. Pp. 280 + 13 plates. (London: H.M. Stationery Office, 1937.) 7s. 6d. net.

and in expert work in connexion with the mapping. It included such men as Hooker, Forbes, Phillips and Playfair (afterwards Lord Playfair), Percy, Hunt, Warrington Smyth and Huxley.

Several of the staff were employed as professors in the School of Mines, which had its home also at Jermyn Street. In spite of this work and their routine duties for the Survey and Museum, time was found for the issue of works on fossils (*Decades and Monographs*), of memoirs on the economic or other geology of districts, and for the delivery of technical lectures and of more popular lectures for working men. The desire of the Prince Consort, who had given whole-hearted support to the plans, to see the School of Mines grow into a more comprehensive scheme for scientific and technical education was thought premature by De la Beche and his successors, and was indeed not fully brought about until 1910, when the Royal School of Mines, the Royal College of Science and the City and Guilds Engineering College were incorporated as the Imperial College of Science and Technology. The School of Mines was, however, largely by Huxley's influence, removed to South Kensington between 1872 and 1883, and many of the books were taken from the library to form the basis of the Science Library there.

Sir Roderic Murchison, as director-general, brought to the institution from outside great organizing ability and valuable social influence. His work (1855-71) was mainly comprised within the framework of his predecessor's scheme, but he strengthened the administration and inspection, and brought about a much-needed increase in staff. All De la Beche's plans of publication were continued, but there was inaugurated the issue of memoirs on individual map sheets, and on several coalfields on which the mapping was being concentrated, while museum handbooks and district memoirs were added to those already published, including Ramsay's great memoir on North Wales. The first index map, of Wales and its borders, on the quarter-inch scale, was also published.

The appointment of Sir Andrew Ramsay as director-general in 1871 illustrates one of the difficulties that have been inherent in the Survey. The duties of inspection, reporting and administration are so heavy that a director must practically abandon all his own field-work, and thus the field staff loses both an inspiration and a standard. Ramsay was certainly one of the finest field-men who ever lived and his loss was most serious in this capacity. Fortunately it proved that his organizing powers were also considerable, but the work speedily wore him out. Under his direction, the first 'drift' maps were prepared, new museum catalogues and handbooks were issued, very valuable collections were acquired by the Museum,

such as the Ludlam collection of 20,000 minerals, and some of the most important memoirs ever written were published, among them that on the Yorkshire coalfield, and those on London, Rutland, and the Weald. The Survey being, up to this date at least, the principal training ground for professional geologists, had to face the inevitable loss of some of its best men to fill teaching posts in universities and colleges and to assume the direction of other surveys.

Sir Archibald Geikie, who had been a member of the Survey for twenty-six years, a great part of that time in sole charge in Scotland as well as professor at Edinburgh, was appointed director-general in 1882, and served in that capacity for twenty years. In accordance with his undertaking, the 'solid' map of England was finished by 1884, and that of Ireland four years after. A 'drift' survey, of as great value to the agriculturist as the 'solid' maps are to the miner, now chiefly claimed attention, and as maps were revised for this purpose they were also brought up to date on the 'solid' side. This entailed the publication of a large number of maps, many of which were now accompanied by sheet memoirs. Some district memoirs, a few on coalfields, the first one on water-resources, and the first complete index map on England and Wales, were also published. But the chief departure, one abandoned by his successors, was the issue of memoirs devoted to individual formations—Jurassic, Cretaceous, etc. Petrology was now put on a level with palaeontology, and specialists were appointed. Teall was brought in to deal with Scottish, and particularly Highland, rocks, and Harker to map and describe the Tertiary igneous complex of Skye. Much was done to exhibit Survey material worthily in museums at Edinburgh and Dublin, and the customary "Annual Report" was converted into a "Summary of Progress", containing some account of the chief discoveries made during the year. This "Summary" has now also become a magazine for communications by the staff. A start was made with the much-needed revision of the coalfields, among others that of South Wales, which was put in charge of Strahan. It expresses the state to which grading and organization in the service had sunk when it is realized that the officer chosen for this highly responsible task was still an 'assistant-geologist' after sixteen years' service, and that he had under him men who had been full 'geologists' for more than twenty years.

The very considerable improvements in organization recommended by the Wharton Committee of 1900 took effect in the appointment in 1901 of Sir Jethro Teall as director, and a new grading and enlargement of the staff. This inaugurated a period of renewed activity. Much coalfield

revision, recommended by the Coal Resources Commission, was carried out in England and Scotland, and many coalfield, coal-chemistry, oil-shale, water and sheet memoirs were published. Field-work was now all executed on the six-inch scale, and the revision published on the 'New Series' ordnance maps. Colour printing replaced the old hand colouring on all one-inch maps, the quarter-inch index, and the new small-scale map of the entire kingdom. Thus maps were cheapened and made available to a much larger public, and it became possible to supply them in quantity at a reduced price for educational purposes. Vertical and horizontal sections were also printed on the map margins. The publication of palaeontological monographs was resumed, and the district memoirs included the great works on Skye, the Highlands and Lowlands of Scotland, and the Isle of Man. Much use was made of photography for illustration as well as in the Museum, and the removal of extraneous collections and of the lecture hall gave fresh space for developing the modified purposes of the building. The Survey of Ireland was separated in 1908, after a series of new drift maps had been published under Lamplugh's direction.

The directorship of Sir Aubrey Strahan (1914-20) was crippled by the Great War, the staff being largely called on for service. What remained of them brought out the publications that were on the stocks and then, with some voluntary help, devoted themselves to writing a new series of memoirs dealing with the mineral resources of the country, many of them seriously needed to replace supplies from abroad now cut off. Water problems and other geological ones at the seats of war were met by members of staff in the army or at home, and special search was made for sources of such things as sand, quartz, oil, refractories, fluorite, sapphire, etc., needed for munitions. At the end of the War, the Survey was taken over from the Board of Education by the new Department of Scientific and Industrial Research; and a Geological Survey Board was formed to assume the duties formerly discharged by a Committee of Advice.

Sir John Flett does not give very full details in his book of the progress under his own directorship, but much can be gleaned of efficiency and progress from what is stated. The staff was enlarged, publication of sheet memoirs and maps was pushed on more actively than even before, the resources memoirs were brought up to more than thirty, coalfield and water memoirs continued to appear, monographs and vertical sections were resumed, and experiments were made on the applications of geophysical apparatus. Uncoloured six-inch maps with geological lines prepared from the field sheets were rendered available.

Co-operation was given to Boards of Fuel and Building Research, to the Inland Water Survey, to the search for oil, and to the making of soil-maps. New rights to information revealed by shafts and borings were acquired, the careful collection of kindred information, often confidential, was continued, and the relations of mutual respect and confidence with the managers of mining and other industrial operations were strengthened. A successful experiment on decentralization was tried, and four centres in the north of England were established. The publication of the last of the great series of memoirs on the Scottish Tertiary volcanic centres contributed what is perhaps the most important addition ever made to knowledge of active as well as extinct volcanoes; and memoirs on concealed coalfields give leading to fresh industrial development.

Meanwhile, probably as a result of the explosion of an aerial bomb in Piccadilly, the Museum had fallen into irreparable disrepair, and much of it had to be closed. When it was clear that repair was out of the question, the Survey Board, and especially its chairman, Sir Francis Ogilvie, seconded by the Museums Commissions, pressed on the Government the need for a new museum. Eventually a site was found and a new building erected, the site of the old one proving so valuable that it may be even said the change was an actual source of profit, a last legacy of the far-seeing De la Beche. The director and his staff carefully planned the utilization of the increased space provided, removed and replaced all the collected material, and devised methods of storage, illustration and display which have given fresh uses and great popularity to the new Museum.

An account is given at the end of the book of the opening of the new Museum and the celebration of the Survey centenary, which were attended by a large concourse of Government and scientific delegates, who came from all parts of the country and all over the world to bring their congratulations and commendation. A group photograph of the delegates and a full list of them are given in an appendix. Other appendixes give a bibliography and a carefully prepared list of nearly three hundred Survey officers who could be traced, with brief notes on their service and career. This list contains the names of four presidents of the Royal Society.

Thus the Survey makes an auspicious and hopeful beginning of its new century, and the author of this work and his colleagues, past and present, are to be congratulated on such a worthy record of a hundred years of sound and faithful work, a justification of the hopes and ambition of its originator, and a valuable asset to the industrial life of the nation.

W. W. WATTS.

Pasture Problems

THE many problems connected with cultivated grassland have recently received considerable emphasis. The International Grassland Congress, meeting at Aberystwyth in July, brought together some four hundred delegates, and further discussion of the subject took place during the Nottingham meeting of the British Association at a joint symposium of Sections K (Botany) and M (Agriculture). An outline of the range of problems there discussed may prove of some general interest.

Grassland problems are largely determined by the perennial nature of the crop, which is a mixture of several species that are in constant competition with one another. These species settle down to a certain equilibrium among themselves, but this is easily upset by changes in the environmental conditions. Rainfall, temperature, sunshine and drought all play their part in encouraging some species at the expense of others, so causing either temporary or permanent changes in the balance of composition of the herbage. The quality and type of herbage are also very dependent upon the general management of manuring and grazing. Uncultivated grassland tends to become very rough and often develops a layer of peat on the surface, but with correct grazing a more even sward is obtained and the more valuable species are encouraged. Land that is always cut for hay bears a different flora from that which is grazed, owing to the variation in the response of species and the two methods of treatment. The time of seeding is also an important factor, and helps to determine the question of survival under cultivation. Wild white clover is a most valuable feeding plant, and is encouraged where land is properly grazed so that competition for light and air is reduced to a minimum.

Of recent years, the work of the Welsh Plant Breeding Station at Aberystwyth has shown the importance of selecting the varieties and strains of grasses that are appropriate for the particular purpose for which they are required. Pasture types and hay types of the same species are radically different in their habits, and success or failure in establishing new areas of grassland largely depends upon the selection of the seeds sown.

In sowing down new pastures, the type of mixture to be used presents its own problems. Complex mixtures of many species and simple mixtures of few species each have their advocates, and no definite ruling can be made as to which is prefer-

able. Much depends upon environment and upon the object that it is desired to attain. Experiments and analyses carried on at Rothamsted for ten years, on land sown with a variety of seeds mixtures, have shown that the ultimate composition of the sward is very similar, regardless of the simplicity or complexity of the mixture initially sown. Some species are short lived, and though they may prove useful in providing grazing for the first year or two, they soon disappear, and their place is taken either by some other constituent of the original seeds mixture or by interloping species which establish themselves naturally. The balance existing between the groups consisting of grasses, leguminous and miscellaneous species may be entirely upset by prolonged drought, which in some cases may kill out the wild white clover, leaving bare spaces which are often invaded later by grass.

In addition to climatic variations, the grazing animal plays a most important part in the development of a sward. The various types of plants in a pasture are all in keen competition, and any factor which weakens one species gives the others a better chance. The grazing animal naturally eats down the most palatable species first, leaving the inferior plants alone except in times of scarcity. The lack of palatability of the latter plants thus affords them protection from grazing and so enables them to increase unduly. Very careful manipulation of the grazing is necessary to prevent this undesirable change in the balance of the species, and controlled grazing periods, together with artificial feeding of the animals at certain critical periods of the year, are necessary to keep the herbage at its best.

During the discussion at Nottingham, special emphasis was laid on the interdependence of the various principles of grassland management. Improvement may be considered from the point of view of the botanical composition of the herbage, pasture and stock management and soil fertility, but whatever is done in one direction is reflected in the reaction of the grassland as a whole. Methods of improvement and management vary in temporary and permanent pastures, and the botanical composition and the yield respond to the contrasting systems of management.

An outstanding problem is the difficulty of getting an accurate measurement of the value of grassland from the point of view of its productivity and feeding capacity. Empirical observations of

the herbage and the stock afford a useful guide to the skilled farmer, but more accurate and quantitative information is necessary for the true comparison of different systems of management. The accurate assessment of yield presents many difficulties, as estimates obtained by continuous cutting to simulate grazing are misleading, since the period and intensity of actual grazing have very far-reaching effects on the sward. In order, therefore, to simulate grazing conditions as closely as possible, experiments of somewhat complex design are necessary, in which there is sufficient replication to permit grazing over the greater part of the experimental period, with infrequent cuts for the actual determination of yield. The type of stock used and variation in seasonal conditions also play their part in complicating the problem.

In the open discussion at the end of the symposium, the question was raised as to the

possibility of laying down some clear directions for the practical man in the management of his sward. From the nature of the case, however, this is an impossibility, as the problems are so complex and the correct methods of management are so diverse. Treatments that are effective in one place, on one type of soil or under certain climatic conditions may be quite unsuccessful elsewhere or in other seasons. Careful observation of the effect of grazing on the sward, together with intelligent use of the results of such observation, are essential for the successful production of first-class pastures providing feed of high nutritive value. Furthermore, recent developments in the improvement of wild hill pastures along economic lines have opened up great possibilities for extended and profitable grazing, provided the active co-operation of the interested farming community is forthcoming.

WINIFRED E. BRENCHELY.

Zoological Expedition to the Oasis of Siwa, Egyptian Libya

By Joseph Omer-Cooper, Rhodes University College, Grahamstown, South Africa

THE Armstrong College Expedition to Siwa, consisting of Dr. Malcolm Cameron, Mr. C. L. Smith and myself was financed by the Royal Society, the Godman Exploration Fund, the Percy Sladen Trust, the British Museum (Natural History) and the Armstrong College Research Fund. Its object was the study of a typical Libyan oasis. We left England in March and returned in October 1935, after spending six months in the Libyan Desert and achieving all our objectives. Transfer from the staff of the Department of Zoology, Armstrong College, Newcastle-on-Tyne, to Grahamstown, South Africa, has been the principal cause of delay in presenting a preliminary report of the Expedition's results.

Siwa is watered by more than two hundred wells and springs. These in many cases flow into storage reservoirs from which the gardens are irrigated. The irrigation waters ultimately flow into pools or lakes from which there is no outlet. These are saline, and if large are known as 'birkets'. The water of the springs is thermal, the bottom water varying from 25° to 29° C. The salinity, which is slightly more variable, appears to be affected by the proximity of the birkets. In Siwa the larger springs, in which concentration by

evaporation was negligible, had a chlorine content of 0.685–1.475 gm. chlorine per litre. The water contains little oxygen. Smith examined water from pipe wells, so obtaining pure samples of the subterranean water, and found only 0.105 c.c.m. oxygen per litre. The water is supersaturated with gas which is more than 97 per cent nitrogen; the residue being oxygen, carbon dioxide and inert gases. As the springs in several other Egyptian oases have the same peculiarities, it is probable that the water is derived from one great subterranean source.

The North African subterranean waters contain a considerable fauna, but no subterranean forms have been recorded from Egypt. This curious fact is adequately explained by the small oxygen content. This also explains the absence of the indigenous Siwan Cyprinodont fish from the larger springs, and the failure of Dr. H. Faouzi to introduce *Tilapia* into these springs, which appear excellently suited to them.

In certain springs the Cyprinodonts have the swim bladder much swollen and are unable to submerge. Some fish are almost globular. This is no doubt due to the water being supersaturated with nitrogen.

Siwa was notorious for immense swarms of mosquitos. It was this, in part, which caused us to choose it for investigation. In 1930 Dr. Zoghbi started an ingenious and successful anti-mosquito campaign. The indigenous Cyprinodont was present in a few of the springs and streams only, and these were much overgrown with reeds, rushes and other vegetation. Dr. Zoghbi had the springs and ditches cleaned, and introduced the fish into those not already containing them. Fortunately for us, during his one year of duty at Siwa, he was unable to deal with all the springs, and by the time we arrived many of these had been long neglected, so that we were able to study the primitive conditions. While we were there, Dr. Zoghbi was again sent to Siwa as medical officer and continued his work. In this he was aided by the successful introduction of *Tilapia* by Dr. Faouzi. Before we left, the mosquito breeding places had been almost eliminated.

The introduction of *Tilapia* by Dr. Faouzi in 1932 has already had an effect. In certain slow-flowing springs, they have multiplied greatly. The change produced is the most striking ecological effect, produced by a single organism, which I have seen. The plants have disappeared and with them the Cyprinodonts, Mollusca and insects; even the Crustacea have been almost eliminated; *Cladocera* are absent and Copepods and Ostracods are scarce. The water, clear in similar springs in which *Tilapia* are absent, is cloudy and contains numerous flagellates, Protozoa and rotifers. The fish feed on the mud. Within a few years it is probable that they will have exterminated the greater part of the aquatic fauna.

Most of the birkets are very saline, and at the most contain a few *Artemia*. At Baharein in the East Lake, there were numbers of minute Hydrophilid beetles but nothing else. The water was cloudy, unpleasant smelling, and had a specific gravity at 60° F. of 1.1498. It is possible that the beetles lived on drowned insects. In an inlet fresh water flowed over the salt water and contained fish. Smith found that the surface temperature was 27.2° C., but it rose rapidly and towards the bottom reached 52.9° C. His observations here and at Siwa show that this temperature gradient was due to solar radiation in the absence of convection currents. At Sitra, springs rose in the lake and the fresh-water spread for some distance over the surface. In these springs were fish which appeared to feed on the *Artemia* living in the saline water. The Birket El Gessabaia had a specific gravity at 60° F. of only 1.0357 and contained a number of marine organisms including diatoms, algæ, *Cardium edule* var., *Mytilus minimus*, *Pirenella conica* and *Balanus* sp. The *Cardium* and *Balanus* were

recent but we found no living specimens, although we obtained living *Mytilus* and *Pirenella*. This fauna is similar to that of the Birket Qarun, and may have been introduced by birds.

In searching our material from El Gessabaia and some other localities for algæ, Dr. Kathleen Blackburn discovered Foraminifera. These were sent to Mr. Heron Allen, who reported that *Trochammina*, *Miliolina*, *Reophax*, *Discorbina* and *Gromia* were present. Some of the species he believes to be identical with those described by L. Gauthier Lièvre from the lakes of the Oued Rhin. None of the species are common Mediterranean forms. This fact, coupled with their occurrence in such widely separated localities, suggests that they may have had a different origin from the recent marine immigrants of El Gessabaia. It is possible that they are very ancient relicts.

It is very generally believed that much of the desert fauna aestivates. My experience of the Somali desert made me sceptical of this and, despite much adverse criticism, we made the summer our chief collecting time. In this we were justified, for, contrary to the general belief, insects proved most numerous in July and August. During the heat of the day there was a striking absence of insects in the open desert, although Hymenoptera were numerous in the oasis. In the evenings and at night, however, insects and arachnids abounded. It is this, no doubt, which has given rise to the popular belief that the fauna aestivates.

One of the objects of the Expedition was to find out whether Siwa is a nodal point in the bird migration. Our observations were sufficient to convince me that it is not. The birds cross the desert on a wide front. The concentration which occurs in the oases is due to the infiltration of stragglers, marooned in the desert.

The insect fauna appeared to be Ethiopic rather than Mediterranean; although, as was to be expected, a considerable proportion consisted of widely distributed forms. The dominant groups were Odonata, Orthoptera, Neuroptera and Hymenoptera: Lepidoptera were also abundant, but Coleoptera and Diptera were scarce. Ancient forms appeared to predominate in the desert regions: *Thysanura*, for example, were numerous. The shifting sands of the desert, like those of the sea, appear to form a refuge for archaic forms of life.

Towards the end of our stay at Siwa, we rarely obtained species not previously captured. This gives us reason to hope that our material is adequate to give a true picture of the ecology of Siwa, and that when the collections have been worked out our results will be reasonably complete.

The British Association and the Indian Science Congress

THE majority of the members of the British scientific delegation to the jubilee meeting of the Indian Science Congress Association (see NATURE, Oct. 9, p. 609) left Tilbury on November 26, on the P. and O. liner *Cathay* for Bombay. Some of the party will join the ship at Marseilles, leaving London overland on Thursday, December 2. The British delegation will include representatives of every major department of science; and several distinguished foreign and other representatives have been invited directly by the Indian Science Congress Association; the party will number in all more than a hundred.

The great majority will make a tour through northern India before the Congress in Calcutta, after an official reception in Bombay (December 16-18), and a visit to Hyderabad, where they will be the guests of the Nizam's Government (December 19-21). Agra will be reached on December 22, and Christmas Eve and Christmas Day will be spent in Delhi. At Dehra Dun (December 26) the Forest Research Institute and the Geodetic Branch of the Survey of India will be visited, and there may be an occasion for a run to Mussoorie for the view of the Siwalik Hills and the outer Himalayas. Benares will be visited on December 27-28, and between this and Calcutta a geological party will diverge southward from the railway. Calcutta will be reached on December 29, and as the Congress will not begin until January 3, it is expected that a number of members will occupy intervening days with excursions to Darjeeling or elsewhere.

It is understood that H.E. the Viceroy will open the Congress, and that Sir James Jeans, as president, will give a brief address and will then communicate to the meeting the presidential address prepared by the late Lord Rutherford, who was to have occupied the president's chair.

The sectional presidents of the Congress are:

- (1) Mathematics and Physics, Dr. C. W. B. Normand, director-general of observatories, Meteorological Office, Poona 5.
- (2) Chemistry, Prof. S. S. Bhatnagar, director, University Chemical Laboratories, Lahore.
- (3) Geology, Mr. D. N. Wadia, officiating superintending geologist, Geological Survey of India, 27 Chowringhee, Calcutta.
- (4) Geography and Geodesy, Dr. A. M. Heron, director, Geological Survey of India.
- (5) Botany, Prof. B. Sahni, professor of botany, University of Lucknow.
- (6) Zoology, Prof. G. Matthai, professor of zoology, Government College, Lahore.
- (7) Entomology, Mr. M. Afzal Husain, principal

of the Punjab Agricultural College, Lyallpur, Punjab.

(8) Anthropology, Dr. B. S. Guha, Zoological Survey of India, Indian Museum, Calcutta.

(9) Agriculture, Rao Bahadur T. S. Venkatraman, Imperial sugar-cane expert, Lawley Road, Coimbatore.

(10) Medical Research, Sir Upendranath Brahmachari, professor of tropical medicine, Carmichael Medical College, Calcutta.

(11) Veterinary Research, Sir Arthur Oliver, animal husbandry expert, Imperial Council of Agricultural Research, New Delhi.

(12) Physiology, Brevet-Colonel R. N. Chopra, officiating director and professor of pharmacology, School of Tropical Medicine, Calcutta.

(13) Psychology, Dr. G. Bose, University College of Science, Calcutta.

The Congress will run from January 3 until January 9, with an intervening day (January 6) for short excursions. Afterwards some fifty of the B.A. party will visit Madras, Bangalore and Mysore, while others will pay individual visits to other places in connexion with their special scientific interests. A large proportion will leave Bombay homeward bound by the S.S. *Strathaird* on January 15. Among the party are:

Dr. F. W. Aston.	Sir Arthur Hill.
Prof. F. G. Baily.	Sir Frederick Hobday.
Prof. E. C. C. Baly.	Dr. O. J. R. Howarth.
Prof. E. Barker.	Prof. G. W. O. Howe.
Prof. V. H. Blackman.	Sir James Jeans.
Prof. P. G. H. Boswell.	Prof. J. E. Lennard-Jones.
Prof. A. H. R. Buller.	Dr. L. Wynn Jones.
Prof. P. A. Buxton.	Mr. R. H. Kinvig.
Mr. J. M. Calie.	Mr. J. McFarlane.
Prof. G. D. Hale Carpenter.	Dr. C. S. Myers.
Prof. N. M. Comber.	Dr. W. G. Ogg.
Prof. F. A. E. Crew.	Prof. A. G. Ogilvie.
Dr. E. M. Crowther.	Mr. H. J. E. Poake.
Prof. Winifred Cullis.	Dr. E. P. Poulton.
Dr. C. D. Darlington.	Prof. H. H. Read.
Prof. C. G. Darwin.	Dr. A. B. Rendle.
Mr. T. S. Dymond.	Prof. H. R. Robinson.
Sir Arthur Eddington.	Dr. R. N. Salaman.
Prof. C. B. Fawcett.	Lt.-Col. R. B. S. Sewell.
Prof. W. G. Fearnside.	Prof. J. L. Simonsen.
Sir Lewis Fermor.	Prof. R. V. Southwell.
Prof. R. A. Fisher.	Prof. C. Spearman.
Prof. H. J. Fleure.	Dr. L. Dudley Stamp.
Prof. F. E. Fritsch.	Prof. F. J. M. Stratton.
Prof. R. Ruggles Gates.	Sir Henry Tizard.
Prof. W. T. Gordon.	Dr. A. E. H. Tutton.
Prof. J. W. Heslop Harrison.	Dr. W. W. Vaughan.
Sir James Henderson.	Dr. J. A. Venn.
Prof. J. Hendrick.	Prof. R. G. White.

The following non-British men of science will also be among the visitors:

- Prof. L. Diels, Botanical Gardens, Berlin.
 Prof. F. von Eickstedt, Anthropological Institute, Breslau.
 Prof. C. G. Jung, University of Zurich.
 Prof. W. Straub, University of Munich.
 Prof. Dr. L. Cipriani, Royal University, Florence.

Obituary Notices

Prof. G. A. Schott, F.R.S.

GEORGE ADOLPHUS SCHOTT was born at Bradford on January 25, 1868. From Bradford Grammar School he went up to Trinity College, Cambridge, in 1886 as a pensioner with an open exhibition in science. He took a first in each part of the Natural Sciences Tripos, and it is interesting to notice, in view of his later career, that his first in the second part of the Tripos was in chemistry. He became a College scholar in 1888 and took his bachelor of arts degree in 1890.

In 1893 Schott was appointed lecturer in physics at the University College of Wales, Aberystwyth. There his interest turned increasingly towards the mathematical side of his subject. During the year 1906-7 he was granted leave of absence to work abroad, chiefly at the University of Bonn, on electromagnetic radiation, the subject which held most of his attention throughout his life. Between 1906 and 1908 he published a series of papers on this subject in the *Philosophical Magazine* and in German periodicals. In 1909 he won the Adam's Prize with an essay based on these papers and entitled "The radiation from electric systems or ions in accelerated motion and the mechanical reactions on their motion which arise from it". His book "Electromagnetic Radiation", published by the Cambridge University Press in 1912, was an extension of this essay, and still remains a standard work on the mathematical aspect of the classical theory.

Schott became lecturer in applied mathematics at Aberystwyth in 1909, and in 1910 was appointed to the chair of applied mathematics there. He was indeed the first holder, and he himself built up the department. Later, in 1923, he became head of both the departments of pure and applied mathematics, and it was only at his own request that the departments were again separated in 1929.

From 1915 or thereabouts until the end of his life, Schott was particularly interested in the new developments of the electromagnetic radiation theory which arose from the relativity and quantum theories. He published a series of papers in the *Proceedings of the Royal Society*, and elsewhere, on topics in this field. He became a doctor of science of the University of London. In 1922 he was elected to fellowship of the Royal Society.

For a considerable period before his retirement, a large part of Schott's time had been devoted to College business. In 1932 he was appointed vice-principal of the College and for a time in 1933, during the illness of the principal, his duties became very heavy indeed. It was typical of him that even during this period of overstrain, the work of his department was not allowed to suffer in the smallest detail.

Dr. Schott retired from the chair of applied mathematics at Aberystwyth in June 1933, but held office as vice-principal until the end of December of

that year. While still in his full powers he died very suddenly on July 15, 1937.

As a mathematician, Schott was a master of technique, his interests ranging over almost the whole field of applied mathematics and mathematical physics. His best work was done in connexion with the classical theory of electromagnetic radiation. It is noteworthy that he maintained until the last that the classical theory had yet to be proved inadequate. His most recent work is concerned with the rigorous calculation of the field of a rigidly electrified sphere and the resulting reaction on the sphere. In particular, he proved that such a sphere is capable of moving in radiationless orbits, a very significant result from the point of view of atomic structure.

The keynotes of his personal character were sincerity and scrupulous attention to detail. His academic distinction was carried with a simple kindness that coloured with affection the deep respect and admiration of his colleagues and students towards him.

WE regret to record the death of Miss B. Pullen-Burry, which took place on September 21 at Hindhead at the age of seventy-nine years. Miss Pullen-Burry, who was born on February 14, 1858, was for many years a familiar figure at anthropological gatherings. She was a staunch believer in the anthropological method of approach in the study of problems of cultural contacts when that point of view had still to win recognition outside certain not very widely extended circles. It was this aspect which she stressed in her communications to the Anthropological Section of the British Association, dealing with the Negro under British rule and in America, and with the natives of New Britain, and afterwards incorporated in her books "Jamaica As It Is" (1903), "Ethiopia in Exile" (1906), and "In a German Colony" (1909). Miss Pullen-Burry travelled extensively in Europe, the Holy Land, Egypt, India, Japan, Australasia, German New Guinea, the West Indies, the United States and Canada. In 1912, she was the first president of the Union of Women of Geographical Interests, an organization which she had a large share in founding.

WE regret to announce the following deaths:

Sir Jagadis Chunder Bose, C.S.I., C.I.E., F.R.S., emeritus professor in the Presidency College, Calcutta, and founder and director of the Bose Research Institute, Calcutta, on November 23, aged seventy-eight years.

Prof. C. Gravier, professor of zoology in the Muséum national d'Histoire naturelle, Paris, on November 14, aged seventy-two years.

Prof. Ludwig Plate, formerly professor of zoology and director of the Phyletic Museum, Jena, aged seventy-five years.

News and Views

Dr. R. R. Marett, F.B.A.

ON November 20, the University of Oxford conferred the honorary degree of D.Litt. upon Dr. Robert Ranulph Marett, rector of Exeter College, Oxford, in recognition of his services to the study of anthropology. Dr. Marett has been closely identified with Oxford for the greater part of his life, first as senior exhibitor of Balliol College, then as fellow, sub-rector and tutor of Exeter College, of which he became rector in succession to the late Dr. L. R. Farnell in 1928. Dr. Marett has held a distinguished position in academic circles as a philosopher since the days when he crowned his career as an undergraduate by winning the Green Essay Prize in Moral Philosophy, after being awarded the Chancellor's Prize for Latin verse; but to the outside world he is best known as an anthropologist, the formulator of the theory of preanimism in the study of primitive religion, the author of a number of books and contributions to scientific publications dealing with the beliefs and ethics of primitive man, as well as a writer on matters of prehistoric archaeology with a knowledge based upon practical experience in cave exploration and excavation.

WITHIN the precincts of the University, however, it is recognized that Dr. Marett's services to the study of anthropology go beyond his personal contributions to research and the advancement of knowledge. He has played the part of pioneer and advocate in organizing facilities within the University for others to pursue these studies. Not only did he take a prominent part in the arrangements for the instruction of officers destined for the Sudan Civil Service, as well as in the institution of a diploma in anthropology, but after the vacation of the professorship of anthropology by the late Sir Edward Tylor, when the chair was virtually in commission, he with the late Prof. Arthur Thomson, the anatomist, and Dr. Henry Balfour of the Pitt-Rivers Museum, were the protagonists in a struggle to secure increased recognition for a subject which had not yet won popularity among academic subjects. It was mainly through Dr. Marett's efforts that the University readership in social anthropology, which he had held for some years, was raised recently to the dignity of a professorial chair.

Dr. R. E. Priestley

THE newly appointed vice-chancellor of the University of Birmingham (see p. 942), Dr. R. E. Priestley, has had a varied career. Born at Tewkesbury and educated at Tewkesbury Grammar School under his father, he proceeded to the University of Bristol. His course there was interrupted when in 1907 he joined Shackleton's expedition to the Antarctic as a geologist and was thus occupied until 1909, when he went to Sydney and resumed his geological studies,

working out with Prof. Edgeworth David the results of the Expedition. In 1913 he joined Scott's antarctic expedition and became a member of the Northern Party, a history of which he gave in his book "Antarctic Adventure". Returning to England after the outbreak of the Great War, he joined the army, going to France with the R.E. Signals and attaining the rank of major and being awarded the M.C. Later, at the War Office he wrote the history of the Signal Service in France and a book called "Breaking the Hindenburg Line". He then went to Christ's College, Cambridge, and took the M.A. degree. He was elected a fellow of Clare College, and ultimately became secretary general of the Faculties of the University. In 1935 he was appointed vice-chancellor of the University of Melbourne and while holding that office he visited many universities in Canada, the United States and New Zealand, thus acquiring knowledge of the problems of the English-speaking university world.

Prof. Carl Neuberg

Enzymologia, the new journal edited by Prof. Carl Oppenheimer, devotes its entire third and fourth volumes, 568 pages in all, to commemorate the sixtieth birthday of Carl Neuberg, which took place on July 29, 1937 (Vol. 3. Neuberg-Festschrift, Teil 1. Pp. xiv + 300 + 5 plates. Vol. 4. Neuberg-Festschrift, Teil 2. Pp. viii + 268 + 9 plates. Den Haag: Dr. W. Junk, 1937. 15 florins each). No fewer than 87 papers by nearly twice that number of colleagues are contributed in honour of Neuberg, all dealing with some branch of the ever-widening enzyme question. It may be recorded that in the course of his forty years activity, he and his students have published 1,000 papers, whilst not the least of his services to his chosen science has been his editorship of the *Biochemische Zeitschrift*, which he founded in 1906 and produced 280 volumes by 1936. The numerical introduction we have given indicates a perfect spate of research and publication far too great to be properly assimilated by any one reader, though it is scarcely necessary to emphasize that Neuberg has to his reputation achievements of outstanding quality, notably his work on fermentation. The writer well remembers him working as a student of A. Wohl in Emil Fischer's laboratory in 1900 onwards, when Neuberg was also acting as assistant to Ernst Salkowski in the pathological institute of the University of Berlin, and may be allowed to use this opportunity to offer him also the congratulations of his English colleagues. Neuberg followed Wassermann in 1920 as director of the Kaiser Wilhelm Institute for Biochemistry in Berlin-Dahlem and has carried out all his work there until he retired last year. He made this institute an outstanding centre of research activity and attracted workers of all countries to it.

Edward Divers, F.R.S. (1837-1912)

AMONG the British men of science and engineers who some sixty years ago laid the foundation of scientific instruction in Japan, none was more highly esteemed than Edward Divers. Born in London on November 27, 1837, he attended the City of London School and then studied under Hofmann at the old College of Chemistry, Oxford Street. He graduated M.D. at Queen's College, Galway, and later was lecturer in materia medica at Queen's College, Birmingham, and in medical jurisprudence at Middlesex Hospital Medical School. In 1873, at the invitation of the Public Works Department of Japan, he, with ten other Englishmen, went to that country to establish a College of Engineering. The first principal of the College was Henry Dyer (1848-1918), but on his return home in 1882, Divers was appointed to succeed him. Later, when the College became a part of the Imperial University, Divers became professor of chemistry in the Department of Science. He remained in Japan until 1899, when he was made emeritus professor. After his retirement, Divers settled in London, where his house became the 'Mecca' of Japanese students visiting England. He received honours from the Japanese Government, and a bronze statue of him was erected in the College courtyard. Most of Divers' original papers were contributed to the *Journals* of the Chemical Society and Society of Chemical Industry. Of the former society he became a vice-president and of the latter he served as president in 1905-6. He died on April 8, 1912, and was buried at Brookwood.

Town Life in Early Britain

DR. R. E. MORTIMER WHEELER's Norman Lockyer Lecture for 1937, which was delivered on November 24, the first occasion on which this lecture of the British Science Guild has been given under the auspices of the British Association, in dealing with the beginnings of town life in Britain in the light of the evidence of recent archaeological investigation, was of marked importance for the history of the growth of civilization among the British people. It was at the same time a striking demonstration of the manner in which modern methods of archaeological research and interpretation are able to illuminate the dark places of history, and even in some instances modify in no small degree inferences from literary and other sources which have attained the status of dogma. Dr. Wheeler's purpose was to test the statement that town life was non-existent in pre-Roman Britain and to check our estimate of the Roman contribution to the urbanization of Britain. Excavations at Wheathampstead and Verulamium, he pointed out, have filled in details of the picture of the British 'city' in Kent and Hertfordshire as given by Caesar, to whom they appeared as fortified woodland clearings. The recent excavations have shown that the size, situation, interdependence and cohesion of these settlements lift them out of the parochialism of a mere peasant kraal.

It is, however, in south-western Britain, on the downlands of Wessex and along the foothills of the

Welsh border that, as Dr. Wheeler went on to show, the most obvious and dramatic vestiges of our pre-Roman communities have survived. Sites of the Iron Age between central Hampshire and eastern Devon alone number upwards of seventy. Such fortified settlements, of which the recently excavated Maiden Castle is a conspicuous example, in their size and their domestic and defensive economy imply no small degree of authority and skill. They can only be designated 'towns' or 'cities' in a full sense of the term. In the light of these new facts—or newly verified facts—it is difficult to deprive the Celtic inhabitants of lowland Britain of the rights of citizenship. But there is another side of the picture; and this modification of the traditional view must not be pressed too far. As Dr. Wheeler indicated, one important element of city life is lacking, namely, commerce. The economic basis of these communities was agricultural and their sphere a given limited tract of country. At Maiden Castle, for example, where hundreds of objects have been recovered in four years' excavation, it is surprising to find how few had been brought from far afield. It was made clear in Dr. Wheeler's account of British organization on and after the Roman occupation that it was this lack of appreciation of the commercial element in civic life that caused the Romanization of Britain to make little permanent impression on the life of the people, except in so far as the villa system gave rise to something in the nature of a squirearchy, which was not foreign to native agricultural tradition—a tale not without a moral for our modern administrators of backward peoples.

Roman Pottery from Ewell, Surrey

It is to be inferred from the number of antiquities of the Roman period which have been discovered at Ewell in Surrey that the Roman township of which it is the modern representative was one of the more important of the stations which research has shown to have been strung out, probably for the convenience of travellers rather than for military purposes, along Roman Stane Street. A recent find of pottery fragments is of more than usual interest, owing to the fact that they are inscribed with names, of which indeed portions only remain, but sufficient to indicate that they have not previously been recorded among the names of the manufacturers of the pottery which was then being imported into Britain from the Continent in something like wholesale quantities. The fragments, which are described in *The Times* of November 8, were found in the south arm of Church Street, between High Street and the old church tower, and consist of two massive amphora handles, and the mouth portion of a mortarium. They are of buff ware and of second century type, the amphora of characteristic Roman form used for the transport of oil and wine, having thick, flat, ringed mouthpieces, made separately and joined to the neck and globular body. It is probable that the amphora of which these are fragments were made in Gaul. The handles were inscribed respectively *buchs* and *oropo*, while the mortarium is inscribed

innis; these, as already mentioned, have not previously been recorded among potters' marks of the period.

Archaeological Research and the Prehistory of India

AN instructive general view of the results of his journeys of archaeological reconnaissance in Southern Persia as a whole was given by Sir Aurel Stein before the East India Association on November 16, when the Marquess of Zetland, Secretary of State for India, was in the chair. As might have been anticipated, Sir Aurel stressed the need for further and intensive archaeological investigation, the aim of which should be to throw light on the dark period covering the Aryan invasion and the beginning of the historic era, when Cyrus, in the middle of the sixth century B.C., extended his dominions to Gandhara, including the whole Kabul valley. It is evident, he pointed out, that the Aryan invader, as may be gathered from the Rig-Veda, had been familiar with a considerable portion of the Indo-Iranian borderland long before they settled in the Punjab. Sir Aurel stressed the gratitude due for the archaeological discoveries of recent years in the Indus Valley, when so much relating to the period of the Aryan invasion must remain conjectural; but, he went on to say, his own explorations of the past few years in the great provinces of Kerman, Fars, Khuzistan and Kermanshah, right up to Kurdistan, had left no doubt about an essentially uniform chalkolithic civilization having prevailed here wherever physical conditions permitted of settled life. Yet nowhere on the ground visited had there been found remains filling the wide chronological gap between the chalkolithic mounds traced in such abundance and the numerous burial sites of Baluchistan and Makran, dating at the earliest from the last centuries before our era. Not until sites abandoned much later than Mohenjodaro had been explored could we hope to learn of the actual state of civilization prevailing in the Indus Valley and beyond at the time of the Aryan invasion.

Destruction of Chinese Centres of Learning

AFTER the great Japanese earthquake of September 1, 1923, when three hundred thousand persons lost their lives, and the buildings of the Imperial University in Tokyo were destroyed, including the loss of about seven hundred thousand volumes in the library, an influential British committee was formed to replace the English section of the library, not only as a token of British sympathy but also as a tribute to the intellectual life of Japan. The calamity which evoked this appeal was a natural one, and unavoidable, but it is ironical now to have to record that Japan itself has destroyed many schools, colleges and universities in China by air raids. We express no opinion upon the causes of the conflict, but we do deplore the barbaric methods of modern warfare which seem to permit no discrimination between combatants and the civilian population, and bring desolation to seats of learning as brutally as to fortified places or other military centres. We are

therefore in complete sympathy with the righteous indignation expressed in a telegram organized by "For Intellectual Liberty", and signed in their individual capacity by more than one hundred members of twenty-two British universities, which was sent to the Minister of Education, Nanking, early last month. The replies received from the Shanghai Association of Universities and Colleges, and from representatives in Hankow of ten universities, show deep appreciation of the sympathetic message from England. "In name of world civilization," say the Hankow colleagues, "we thank you for your noble sentiment and moral support. We request you will give unswerving attention to prevent Far Eastern crisis and lend us further support in mobilising all British intellectual and humanitarian forces to the side of our common cause of international justice, which if humanity would exist must prevail."

Jews in Poland

THE Warsaw correspondent of *The Times* wrote on October 6 describing a system whereby Jewish students are being divided from 'Aryan' students in the lecture rooms of the Warsaw Polytechnic. Part of the benches have been marked for students belonging to a union almost exclusively controlled by 'Aryans', and others for the Jewish students' union, while a few seats for non-union students are left unmarked. The University of Warsaw has its seats numbered, and students sit according to the numbers on their identity cards. All 'Aryan' students, who have even numbers, occupy one half of the room. Unlike the Polytechnic, the University has no unmarked seats. It is stated that other educational establishments in Poland will probably follow suit. In the issue of *The Times* of November 18, appears a letter signed by Prof. George Barger, Mr. G. D. H. Cole, Mr. T. Edmund Harvey, Dr. Julian Huxley, Prof. Norman Kemp Smith and Prof. J. B. Trend, referring to the apparent surrendering of the authorities of the high schools and universities to the agitation of anti-Semitic students. They state that the Minister of Education, a year ago, gave an assurance that separate benches would never be introduced in the universities. They ask, "Will it enhance the good name or the welfare of the Polish republic if such a spirit of intolerance is officially allowed and deliberately fostered in the very institutions in which are trained our future legislators and administrators?"

Foot-and-Mouth Disease

THE outbreak of foot-and-mouth disease in the eastern counties of England has produced the usual crop of suggestions, in the form of letters to the daily Press, for dealing with this scourge. It is evidently not widely known that a Foot-and-Mouth Disease Research Committee is in existence, and published a substantial fifth Progress Report on its work so recently as early last summer (see *NATURE*, June 19, p. 1033). Replying to questions on November 15 in the House of Commons, the Minister of Agriculture, Mr. W. S. Morrison, referred to the work of this Committee, and stated that "the most effective

method of preventing the spread of infection is the prompt slaughter of affected animals and those in immediate contact". The work of the Research Committee is costing, he said, £16,000-£17,000 a year. In a written reply to a question, Mr. Morrison stated that the Government has paid out £4,900,233 in compensation for animals slaughtered on account of foot-and-mouth disease during the twenty years 1917-36. The Royal Society for the Protection of Birds has issued a circular letter asking if there is any evidence that starlings and other birds are responsible for bringing infection into England. The Research Committee, in its report referred to above, does not apparently favour the view that birds are responsible, but nevertheless Mr. Morrison declared that in the opinion of the Ministry, "the present outbreak is caused by migrant birds".

Monument to Wireless Pioneers

A GRANITE column has been erected by the Marconi Company at Poldhu Cove, Cornwall, on November 21, to mark the site of the former Poldhu wireless station. A plaque on the monument states that the Poldhu wireless station, designed by J. A. (now Sir Ambrose) Fleming, occupied that site from 1900 until 1933. A second plaque states that the Poldhu station was used for the first trans-oceanic service of wireless telegraphy, which was opened with a second Marconi station at Glace Bay, in Canada, in 1902. There is also a third plaque, which commemorates the fact that in 1923 and 1924 C. S. Franklin, inventor of the Franklin beam aerial, directed from there his short-wave wireless beam transmission to Marconi on his yacht *Eletra*, cruising in the South Atlantic. These experiments laid the foundation of modern high-speed radio-telegraphic communication to and from all quarters of the globe. Mr. H. A. White, chairman of the Marconi Company, who presided, said that Marconi had always realized that inventors working under the auspices of the company which bore his name do not usually receive adequate recognition. Most of the success of modern methods of radio-telegraphy and radiotelephony, and many other wonderful achievements in scientific technique, can be traced back to Sir Ambrose Fleming's invention of the thermionic valve in 1904.

The German *Autobahnen*

CONSIDERABLE attention has been given recently by scientific and technical workers to the remarkable system of new motorways now in course of construction by the German Government, at the invitation of which a delegation from Great Britain recently made a tour of inspection of the roads, both those in course of construction and also those now completed. Of the latter, 650 miles were opened to traffic on September 27, 1936, and it is stated that another 650 miles will be completed each year until a total of some 4,500 miles of new roads are constructed. Only mechanically propelled vehicles are permitted to use the *Autobahnen*, and the requisite land is purchased by the German Government, proprietors refusing to sell being expropriated, an exchange process between adjacent plots being arranged in

such cases. The work gives employment to about 250,000 workers, and is financed directly by the Reich. Dual concrete carriageways, clover-leaf intersections, and transition curves suited to high-speed traffic are adopted, through and local traffic are segregated, and the mixing, placing, consolidation and finishing of the concrete surfaces is done by mechanical means throughout.

It is understood that the delegation which visited these roads, composed of representatives of the Automobile Association, the Royal Automobile Club, and the British Road Federation, together with various technical experts, has been asked by the Minister of Transport to present to him its considered views on the German *Autobahnen*; and at the meeting of the Public Works Congress in London last week, a private session of the delegates was held at which the best method of preparing such a report was discussed. It is clear that although all who have seen these new roads have been greatly impressed by them as an engineering achievement, there is by no means unanimity of opinion in technical circles as to their applicability to conditions in Great Britain. Questions as to land values, possible effect on railway interests, the smaller size of Great Britain as compared with Germany, distribution of industry, and the strategical aspect, make the matter a difficult problem. It is suspected that methods easy of adoption in a totalitarian State may prove to be an entirely different proposition in Great Britain.

Richard Watson and the Constitution of Elements

PROF. H. A. HARRIS, of the Anatomy School, Cambridge, has directed our attention to a statement by Richard Watson (1737-1816), bishop of Llandaff and professor of chemistry at Cambridge, an account of whose work was recently given by Prof. J. R. Partington (*Chemistry and Industry*, 56, 819; 1937). Prof. Harris quotes from Watson's "Chemical Essays" (vol. 4, Essay 7), "Of the Transmutability of Water into Earth", in which he says "the diversities of bodies subsisting in the universe, will no longer be attributed to the different combinations of earth, air, fire and water, as distinct, undecomposed, immutable principles; but to the different magnitudes, figures, and arrangements of particles of matter of the same kind". This idea of a composition of particles of what were then believed to be elements from simpler particles in different arrangements and motions is to be found also in the "Sceptical Chymist" of Robert Boyle, written in 1661, in which he says: "The greatest part of the affections of matter, and consequently of the Phaenomena of nature, seems to depend upon the motion and the contrivance of the small parts of Bodies", and that "the difference of Bodies may depend merely upon that of the schemes whereinto their common matter is put . . . so that according as the small parts of matter recede from each other, or work upon each other . . . a Body of this or that denomination is produced". In these statements of Boyle and Watson an idea of the present view of the structure of the elements is expressed.

Public Health in Great Britain

IN his annual report for 1936, published last week, Sir Arthur MacNalty, Chief Medical Officer of the Ministry of Health, points out that this year of the Coronation is also the centenary of Queen Victoria's accession, and he takes the opportunity to present an impressive statement of the remarkable progress that has been made in national health and in medicine in the past hundred years and of the amazing decline in mortality rates during that period. For 1936, the crude death-rate was 12.1 per 1,000 living, compared with 22.4 in the eighteen forties, the infant mortality rate was 59 as against 153, and the number of infants who died at less than one year of age was 35,425—less than half the number who would have died under conditions of as little as thirty years ago. The standardized death-rate from tuberculosis, respiratory and non-respiratory, was 657 per million living, compared with an average of 3,476 in the fifties of last century. There is an increase in the mortality from cancer, the number of deaths being 66,354, an increase of 1,847 on the previous year, which is a larger increase than that in 1935 over 1934. The maternal mortality rate was 3.8 per 1,000 live births, the lowest recorded since 1923. Reference is made to the importance of the consumption of a sufficient quantity of milk, described as "the key to proper nutrition", and commendation is expressed for properly operated milk bars. The report points out the risk of skin affections from the use of certain substances in lip-stick, hair-dye, face cream and other cosmetics, but observes that untoward results are relatively very few. Reference is made, in conclusion, to the national health services, the need for knowledge of these services, and to the intensive national health campaign organized and launched this autumn.

Photo-electric Control in Industry

AT the Nottingham meeting of the British Association, Mr. A. L. Whiteley contributed to Section A a paper on photo-electric control in industry. The photo-electric cell provides greater rapidity of action and a higher sensitivity than other light-sensitive devices. The greatest field for it is the talking picture industry, but this does not come under the subject of his paper. In industry the cells are usually made in standard sets called photo-electric relays, containing an amplifier circuit and a small contactor capable of making or breaking 15 amperes. An obvious application of this unit is counting objects on a conveyor belt or vehicles passing on a road. It can easily be used to make the pointer of an instrument actuate an external circuit on reaching a pre-determined scale reading. Applications of this nature include automatic weighing of mass-produced parts and automatic termination of operations on high precision grinders when a mechanical gauge records that a certain diameter of the part operated on has been reached. It is also used to control street lighting according to variations in the intensity of the light. In many types of automatic wrapping and bag-making machines a continuous preprinted web of paper or "Cellophane" is fed to the machine at a high speed. It is necessary that positional relation-

ship between the printed matter and the fold or cut be maintained. This is done by the response of the printed matter itself. The system is used abroad to maintain 'register' between the design and the perforations of postage stamps. It can be applied to record the intensity of the smoke coming from a chimney and the temperature of strip steel as it comes from the hot rolls of a rolling mill.

Blood Groups in Central Africa

MR. R. ELSDON-DEW, of the South African Institute for Medical Research, Johannesburg, has recently returned from his six months' expedition to Central Africa for research on the blood-grouping of the various native inhabitants of this region. In a communication to the Editor, he has included a long table of percentages based on his observations, for which space cannot be found. His investigations covered tribes of Rhodesia, Nyasaland, Tanganyika, Kenya and Uganda, reaching so far north as to the Nilotic peoples of the lowlands to the north-east of the great lakes. In all, thirty-four tribes or groups of peoples were examined, the numbers in each group ranging from one hundred and twenty-three (Tumbuka) to five hundred and seventy-six (Yao). In the majority of instances, however, the numbers were between four and five hundred, thus approximating in size to the eleven groups of natives of South Africa previously reported (see NATURE, July 10, 1937, p. 77), each of which numbered five hundred. These later results have not yet been analysed, so that any inference from the observations would be premature; but the percentages of the groups already worked out suggest that the analysis, when completed by Mr. Elsdon-Dew, will prove not only of great serological interest, but will also afford material of considerable significance for the ethnologist. These percentages follow the results of the earlier investigation in suggesting a striking tendency to the predominance of the O group among Bantu-speaking peoples. In the thirty-four sets of observations, the O group is less than 50 per cent in six instances only. In fourteen it ranges from 50 to 60 per cent, in twelve from 60 per cent to 70 per cent, and in two it is more than 70 per cent. Among the Wagogo the grouping is: O, 73.1; A, 19.6; B, 5.8; AB, 1.6; among the Vandau: O, 74.4; A, 13.4; B, 10.4; AB, 1.8. The highest percentage of A appears in the Wakamba: O, 53.3; A, 31.8; B, 12.9; AB, 2.0; and the highest B among the Lango (Nilote): O, 41.1; A, 27.6; B, 28.9; AB, 2.4.

Cables for 200,000 volt Pressures

FOR several years, research has been made in the laboratories of Callender's Cable Company with the object of designing an underground cable which will withstand the high electric pressures necessary for the economic transmission of electric energy over considerable distances. The new impregnated cable has now undergone a continuous test of 5,000 hours at 200 kilovolts and the application of numerous heat cycles during this period. According to the *Electrician* of November 19, it has also passed through the

official tests in Holland. This cable marks a very notable advance in the transmission of electric energy underground and will be most useful in the neighbourhood of towns and in populous districts. The dielectric is similar to that used in the 'solid' type of cable, but after the installation has been completed, dried nitrogen gas under pressure is admitted to the cable. The pressure used is 200 lb. per square inch and the gas finds its way along the cable in the narrow space between the dielectric and the lead sheath. All the dielectric is subjected to this pressure and so any void spaces which form in it during the working of the cable must contain gas at this high pressure. The electric strength of the void space will therefore be much greater than if the gas were absent. Very long continuous cables can be made in this way; no supplementary feed points are required. The strength required to withstand the high internal gas pressure is afforded by strengthening the lead sheath with copper tapes. The cable is treated just like the normal solid type cable during transport and installation. The point of entry of the gas is at the base of two sealing ends, and it is buried to a depth of about a yard. The cross-section of the conductor is about 0.65 sq. in. and the overall diameter is 3.46 in. The losses in the dielectric as compared with a solid cable have been reduced by 25 per cent, and there is no increase in the losses with rise of temperature.

National Institute of Sciences, India

At a meeting of the Council of the National Institute of Sciences of India held on November 6 the following were elected fellows of the Institute: *Ordinary fellows*: Prof. Y. Bharadwaja, professor of botany, Benares Hindu University, Benares; Dr. B. L. Bhatia, principal, Government College, Hoshiarpur; Prof. G. R. Paranjpe, professor of physics, Royal Institute of Science, Bombay; Dr. H. Srinivasa Rao, assistant superintendent, Zoological Survey of India, Calcutta; Dr. K. Rangadharma Rao, reader in physics, Andhra University, Waltair; Prof. M. R. Siddiqi, professor of mathematics, Osmania University, Hyderabad-Deccan; Prof. A. C. Sircar, professor of chemistry, Presidency College, Calcutta; Dr. M. B. Soparkar, medical officer, Plague Research Inquiry, Haffkine Institute, Parel, Bombay; Sir Shah S. Sulaiman, judge of the Federal Court of India, New Delhi; and Col. F. C. Temple, chartered civil engineer, Calcutta. *Honorary fellows*: Prof. Ludwig Diels, director of the Botanical Gardens, Berlin-Dahlem, Germany; Sir James G. Frazer, London; Prof. Robert Robinson, Waynflete professor of organic chemistry, University of Oxford; Dr. C. M. Wenyon, director-in-chief, Wellcome Bureau of Scientific Research, London.

The Oxford Farming Conference

In view of the interest aroused by the two conferences already held, the Oxford Farming Conference is to be established as an annual event. At the same time it has been decided that in future years the Conference shall not be confined to mechanized farming but shall provide a common

meeting ground for farmers, research workers and others, at which any subjects of particular interest to British agriculture may be discussed. The next Conference will be held on January 4-7, 1938, and will deal mainly with the maintenance of fertility, with special reference to the Government's new agricultural policy and to the control of weeds and pests. Further information can be obtained from the Conference Secretary, 10 Parks Road, Oxford.

Electron Diffraction in Crystals

DR. P. P. EWALD, writing from the Crystallographic Laboratory, Cambridge, with reference to the note on the Nobel Prize award to Dr. C. J. Davisson and Prof. G. P. Thomson for work on this subject (*NATURE*, Nov. 20, p. 882), points out that W. Elsasser predicted the effect in 1925. Elsasser's work is mentioned early in a paper by Prof. G. I. Finch and H. Wilman entitled "Study of the Surface Structure by Electron Diffraction" published in *Ergebnisse der Exakten Naturwissenschaften*, 16, 353-436 (1937), to which reference can be made for a review of the subject. In the course of two paragraphs dealing mainly with the work of Dr. Davisson and Prof. Thomson, it was neither possible nor desirable to attempt to survey the whole field of electron diffraction.

Observation of the Orionid Meteors

MOHD. A. R. KHAN informs us that he carried out observations of this shower at Begumpet, Deccan, on October 18-20, in spite of the difficulties attending strong moonlight. Altogether he observed forty-one Orionids, and his results again confirmed the easterly movement of the radiant, the positions of which on October 18 and 20 were respectively R.A. 6^h 5^m, Decl. 15° N; R. A. 6^h 15^m, Decl. 15° N.

Annular Eclipse of the Sun, December 2-3

An annular eclipse of the sun will take place on December 2-3 but will be invisible from Europe. The path of annular eclipse, which will cross the Pacific Ocean, extends from long. 139.4° E., lat. 26.4° N. to long. 115.0° W. lat. 21.8° N.; the respective times of beginning and ending of annular eclipse corresponding to the extremities of this path are December 2^d 21^h 18^m and December 3^d 0^h 52^m. Washington Island and Fanning Island in mid-Pacific lie on the track, the duration of the annular phase at these places being about 11½ minutes.

New Minor Planet close to the Earth

HERR K. REINMUTH, Königstuhl, discovered an object, magnitude 10, on October 28, the position being R.A. 1^h 34.2^m, N. Decl. 8° 6'. It was moving rapidly—an indication of proximity to the earth. Other observations were made, but as these extended only over three days, the orbit derived is very rough. It is moving at a small inclination to the ecliptic, probably not exceeding 6°, and has a perihelion distance of about 0.6. The remarkable thing is the close approach to the earth at the end of October, namely, less than 700,000 miles. In *Mon. Not. Roy. Astro. Soc.*, 92, 7 (May 1932), Dr. Davidson gave a

description of Minor Planet 1932 HA, which came to $6\frac{1}{2}$ million miles from the earth, and predicted the discovery of other similar objects. Since then Adonis was discovered in 1936 and made an approach to the earth of $1\frac{1}{2}$ million miles. The recent planet, 1937 UB, has made the closest approach of any, but it is quite possible that others may be discovered nearer still. These small objects present certain very interesting features in connexion with the evolutionary history of our solar system.

The Night Sky in December

At the time of the winter solstice on December 22, the night lasts $16\frac{1}{2}$ hours in the latitude of London. The moon is now on December 2 at 23.2^h and full on December 17 at 18.9^h U.T. Mercury is an evening star setting at about 17^h, but the planet will be difficult to see, even at the time of greatest elongation (21° east) on December 12. Venus rises as a bright star in the late dawn. Mars, Jupiter and Saturn are evening stars, their respective times of southing in mid-December being 16.3^h, 14.6^h and 18.3^h. Conjunctions between the planets and the moon occur as follows: Mercury on December 4^d 17^h; Venus on December 1^d 14^h; Mars on December 9^d 0^h; Jupiter on December 7^d 0^h and Saturn on December 12^d 1^h. At 22^h in the middle of the month, Algol, Capella, the Pleiades and Aldebaran are near the meridian. The variability of Algol may be watched about $1\frac{1}{2}$ hours before and after the following times: December 3^d 0.7^h, 5^d 21.5^h, 8^d 18.3^h, 20^d 5.6^h, 23^d 2.5^h, 25^d 23.3^h, 28^d 20.1^h and 31^d 17.0^h. Comet Encke is traversing the constellation of Ophiuchus; according to Crommelin's ephemeris given in *B.A.A. Handbook*, p. 34, the comet will reach perihelion on December 27. The Geminid meteors, at maximum frequency about December 10, have their radiant point west of Castor. On a clear night, two nebulae that are very different in nature may be seen with the naked eye. The great nebula in Orion, situated within our stellar system, is a very extensive gaseous nebula nearly 600 light years from the earth. The great Andromeda nebula, 800,000 light years away, is one of the nearest two of a vast host of extra-galactic nebulae extending into remotest space.

Announcements

THE Symons Gold Medal for 1938 of the Royal Meteorological Society has been awarded to Dr. G. M. B. Dobson, reader in meteorology in the University of Oxford.

SIR KINGSLEY WOOD has announced that an inquiry is to be held into the causes leading up to the outbreak of typhoid fever in Croydon, and the steps taken to deal with it. The inquiry will be held by Mr. H. L. Murphy, K.C., who will have as assessors Sir Humphry Rolleston, lately regius professor of physic at Cambridge, and a former president of the Royal College of Physicians, and Mr. H. J. F. Gourley, a past president of the Institution of Water Engineers.

DR. E. F. ARMSTRONG gave away the prizes and delivered an address at the annual prize distribution

and conversazione of the Birmingham Central Technical College on November 17. He was then awarded an honorary associateship of the College. This distinction was inaugurated last year when it was given to Lord Austin, Dr. Sumpner, the first principal of the College, and Dr. C. C. Paterson.

THE RIGHT HON. LORD MACMILLAN will open the new buildings in Foster Court of University College, London, on December 1 at 2.45 p.m. After the opening ceremony, the new buildings (the Foster Court Library, the rooms of the Faculty of Laws, the Departments of Geography and Archaeology, the Junior Laboratory of the Department of Physics and the Department of Zoology) will be open for inspection.

A SPECIAL programme of films on scientific subjects will be shown at the Academy Cinema, Oxford Street, London, on Sunday, December 12, at 2.30 p.m., under the auspices of the Scientific Film Group of the Association of Scientific Workers. Tickets, price 1s. and 1s. 6d., may be obtained, prior to the day of performance, from the Secretary, Association of Scientific Workers, Kelvin House, 28 Hogarth Road, S.W.5, or from Film Centre, 34 Soho Square, W.1.

ON November 19, Capt. G. E. T. Eyston broke the world land speed record at Bonneville Salt Flats, Utah, in his car *Thunderbolt* by driving twice over the measured kilometre at an average speed of 312.20 miles per hour. Sir Malcolm Campbell held the previous record with an average of 301.47 miles per hour. *Thunderbolt* has two Rolls-Royce engines, each capable of developing 2,350 horse-power.

Flying Officer A. E. Clouston and Mrs. Kirby-Green returned to London from Capetown on November 20 in their Comet aeroplane, after making another record (*NATURE* of November 20, p. 388). The journeys were made in 5 days 17 hr. 28 min. The outward journey was done in the record time of 45 hr. 2 min., and the return journey in 57 hr. 23 min., the latter beating the previous best time by 39 hours. The round trip was faster by 88 hr. than any hitherto made. Another record was set up on November 22, when M. Codos and three companions flew from France to the Argentine in 48 $\frac{1}{2}$ hours.

A REPORT has been prepared by a joint committee consisting of representatives of the British Rainfall Organization, the Institution of Water Engineers and the Royal Meteorological Society, appointed to consider methods for determining rainfall over any area. The report will be discussed at the general meeting of the Institution of Water Engineers to be held in the rooms of the Institution of Civil Engineers, Great George Street, Westminster, on December 10, at 2.15 p.m. Advance copies of the report can be obtained by members of the institutes concerned from their assistant secretaries.

A CHAIR of social medicine has recently been founded in the Paris Faculty of Medicine with Dr. Crouzon as its first occupant.

Letters to the Editor

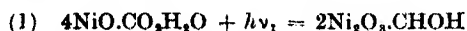
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 935.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Photosynthesis of Carbohydrates *in vitro*

It has been proved that carbohydrates are photosynthesized when a surface of pure nickel oxide coated with an adsorbed layer of hydrated carbon dioxide is irradiated with white light. The photosynthesis is accomplished by two successive photochemical reactions which are as follows:



where $h\nu_1$ is a quantum of blue light ($\lambda = 4000 \text{ \AA.}$), $h\nu_2$ is a quantum of red light ($\lambda = 6400 \text{ \AA.}$), and CHOH represents a molecule of activated formaldehyde which polymerizes on the surface to a carbohydrate. These two processes are followed by a thermal or dark reaction:



which takes place in the presence of hydrated carbon dioxide, with the result that the photosynthesis is continuous.

The first product of photosynthesis is a complex carbohydrate which is unstable and undergoes polymerization or condensation into a still more complex carbohydrate which is stable in solution. This second complex substance when thus formed in solution does not appear to be hydrolysed by acid or by diastase. If, however, this substance is deposited on a surface, it at once becomes capable of hydrolysis by diastase to reducing sugars. The stable complex carbohydrate appears, therefore, to be the hitherto unknown parent of a starch, since as the result of its deposition on a surface it becomes endowed with the characteristic property of starch, namely, its ready hydrolysis by diastase.

The stoichiometric relations shown by the two photochemical reactions indicate that the essential criterion of success is a surface of a true crystalline lattice of nickel oxide. Owing to the remarkable power which the hydroxide and carbonate possess of adsorbing hydroxyl ions, thereby becoming highly dispersed, considerable difficulty has been met with in preparing satisfactory surfaces of nickel oxide. Indeed all failures to achieve photosynthesis have been due to the dispersion of the nickel compound by alkali. This difficulty has now been overcome, and two methods of preparation have been standardized.

E. C. C. BALY.

University,
Liverpool.
Nov. 6.

Spectrum of Nitrogen and Atmospheric Pressure at High Altitudes

IN a series of experiments on the excitation of nitrogen bands by a controlled electronic bombardment, I have observed, as Dr. Kaplan did¹, the great modifications of the spectrum which accompany any change in the experimental conditions. As the pressure decreases, the intensity of the negative system of bands (emitted by N_2^+ ions) increases in comparison with that of the second positive system. On account of the rarity of collisions, the average energy of the exciting particles (ions or electrons) rises progressively and, at the same time, the probability of excitation of the negative bands becomes higher².

Dr. Kaplan proposes a simple method for obtaining the actual value of the atmospheric pressure between the boundaries of the auroral zone, that is, 100 km. and 1,000 km. After measuring the altitude of one aurora and observing its spectrum, it would be sufficient, in laboratory experiments, to seek for the pressure which permits the reproduction of a similar spectrum.

The idea is attractive, but we can oppose to it serious objections. Observation of auroral displays having a height of several hundreds of kilometres shows that the spectral composition is nearly the same at each point. This fact excludes any important influence of the pressure. Such an influence should enhance considerably, at the lower limit of the aurora, the bands of the second positive system of nitrogen, chiefly for low-altitude auroras. It seems that this change has never been observed. Moreover, it would be now difficult to question the electronic origin of the aurora. Admitting this view, I have recently shown that the only factor capable of altering the relative intensities of the radiations emitted is the energy of the electrons. Making use of photometric comparisons, as suggested by Dr. Kaplan, I even succeeded in assigning to the aurora a definite potential of excitation³. The development of this work is now going on at the Auroral Observatory of Tromsø.

In conclusion, the influence of the pressure on the composition of the afterglow spectrum is probably too complex a phenomenon to be considered as a source of precise information on the physical state of the upper atmosphere.

RENÉ BERNARD.

Institut de Physique Générale,
Université de Lyon.
Oct. 25.

¹ NATURE, 139, 1112 (June 26, 1937).

² C.R. Acad. Sci., 204, 489 (1937).

³ C.R. Acad. Sci., 204, 893 (1937).

Abnormal Zenithal Distribution of Cosmic Rays

MANY experimenters, and especially Auger and Ehrenfest, have shown that the intensity of cosmic rays, measured by counter coincidences, at different zenithal angles, is different from what it should be as deduced from the variation of vertical intensity at various heights in the atmosphere.

The intensity at a zenithal angle of 45° and at an altitude corresponding to a pressure of 0.7 atmosphere is about 30 per cent less than the vertical intensity at sea-level, unless the rays have to cross the same equivalent depth of air, supposing the composition of the atmosphere independent of altitude.

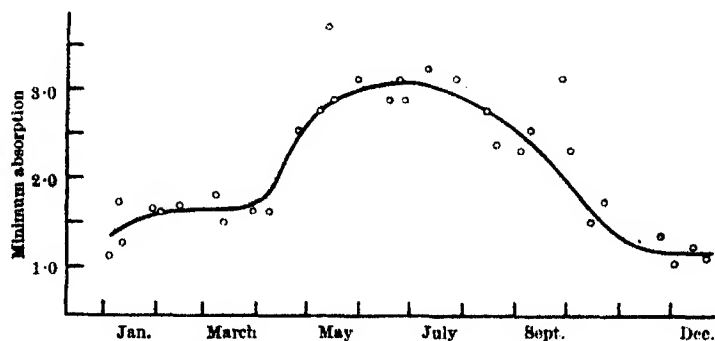
An absorbing layer, on the top of atmosphere, more absorbing than air for corresponding densities, would explain the anomaly, but the existence of such a layer is not easy to justify. I suggest that the whole of the anomaly would also be explained by taking into account the diffusion of cosmic rays in the air. A very rough calculation shows that a mean deviation of 20° in a screen of 1,000 gm. cm^{-2} is sufficient to explain the observed facts. Such a value for the diffusion does not seem to me to be in opposition with the known properties of the cosmic rays.

In seeking a quantitative justification of that hypothesis, a more elaborate calculation of the effect to be expected is now in progress, and will be published soon.

MAX G. E. COSYNS.

"Fondation Medicale Reine Elisabeth",
Brussels.
Oct. 26.

Some evidence of the variation of the minimum absorption from winter to summer has already been given. Since the publication of the previous results, however, the work has been continued and the annual variation in the magnitude of the absorption in the lower zone has been more definitely established. The complete results for the period, January-December 1935, are shown in the accompanying figure.



The lower zone of absorption is more absorbing in summer than in winter, the ratio of the mid-summer value of $f.k.ds$ to the midwinter value being 2.27.

F. W. G. WHITE.

Canterbury University College,
Christchurch, C.I, N.Z.

L. W. BROWN.

"Brean", Moron Avenue,
Broomfield, Chelmsford.
Oct. 23.

*White and Brown, *Proc. Roy. Soc., A*, 153, 639-660 (1936).

Annual Variation of the Absorption of Wireless Waves in the Ionosphere

A WIRELESS wave, incident normally on the ionized regions in the upper atmosphere, will, under suitable conditions of ionization and frequency, be returned to the earth from the F region. By the method described previously¹, the magnitude of the total absorption suffered by the wave in its atmospheric path ($f.k.ds$) may be determined as a function of the frequency of the wave at any given time of day. From measurements made at noon, with the emitting station at King's College, London, and the receiver at the Halley Stewart Laboratory, Hampstead, it has been shown that on any day the absorption has a minimum value, different from zero, provided that the frequency of the wave is not near the critical frequency for a reflecting region. As a critical frequency is approached, the absorption increases, but at other frequencies the minimum value of the absorption is independent of frequency, to the accuracy possible in this work.

This result indicates that there are two zones of absorption for waves reflected from the F region. The first is at the top of the wave trajectory and is of importance only at frequencies near the critical frequency for a reflecting region. The second is lower in the atmosphere, and the waves pass through it twice in their journey to and from the F region. The latter is principally effective in causing the minimum absorption mentioned above.

Cytology of *Lepidosiren*

I HAVE just seen the issue of NATURE of August 28, in which Prof. E. W. MacBride refers to an early work of mine on the spermatogenesis of *Lepidosiren*. Although a reply after such a long interval loses much of its point, his use of that work as a disproof of the chromosome theory of heredity is so surprising that I feel that a reply is desirable.

My account of the longitudinal pairing of the homologous chromosomes in the zygotene stage, and the subsequent re-pairing of the temporarily separated ex-conjugants, is made to read very strangely by MacBride's using, as interchangeable terms, the pairing of the homologues prior to meiosis, and meiosis itself. But the main object of this reply is to state that I can see nothing in my description of the meiotic phase in this animal which is inconsistent with the now generally accepted view of the arrangement of genes in the chromosomes, and the genetic theory of crossing-over. The peculiarity in *Lepidosiren* consists merely in the unusually complete temporary separation of the ex-conjugants between the zygotene stage and the placing of the bivalents on the spindle of the first division. As I pointed out in my original paper (1911), this is in favour of the hypothesis that the pairing of the homologues performs a double function—that of allowing an interchange between them, and that of associating them together in the correct

relations for the meiotic division. Prof. MacBride does not believe in this double function; but he cannot logically cite the case of *Lepidosiren* (and similar cases which have been described) as evidence against it.

W. E. AGAR.

University, Melbourne.
Oct. 11.

PROF AGAR has read with insufficient care my article on "Mendel, Morgan and Genetics" which was published in NATURE of August 28. I reproduced in that article two drawings of the figures given by Prof. Agar of two meiotic "pairings" within the same nuclear cycle. I further said that Prof. Agar's hypothesis to explain these was plainly incredible and I gave the credit for perceiving that *Lepidosiren* would furnish a critical case for testing the "crossing-over" theory and for planning the research to Prof. Agar's teacher, Prof. Graham Kerr.

Prof. Agar's statement "the now generally accepted view of the arrangement of genes in the chromosomes, and the genetic theory of crossing-over" is pure assertion. Amongst the foremost zoologists in Great Britain—those who have really the right to speak on the specific problem—there is a widespread scorn of the whole 'gene' theory, and to say that this theory is "generally accepted" in view of the evidence given in my article, of the bitter regret of Johannsen that he had ever invented the word 'gene', of Mohr's statement that 'genes' responsible for mutations continually occur in all chromosomes and are all expressions of a lowered vitality, and finally of the view of the Development Commission that factors valuable to the former do not 'mendelize', is simply obscurantism—a deliberate shutting of the eyes to unwelcome truth.

West Bank, near Alton, E. W. MACBRIDE.
Hants.
Nov. 3.

Gene Doublets as Evidence for Adjacent Small Duplications in *Drosophila*

It is to be assumed—by analogy with the cell, the nucleus and individual chromosomes—that genes are always derived from parent genes, and are not created *de novo* from non-genic material. Evolution, as seen in the phenotype, must go hand in hand with an increase of the number of genes. Polyploidy as a method of increase of gene numbers is common in plants, but does not seem to have played an important part in the evolution of animals. The work of Bridges¹ on salivary gland chromosomes in *Drosophila* shows that small duplications, often adjacent, are common in *Drosophila*. They appear as 'repeat' sequences of very similar or identical bands; when extensive enough, these 'repeats' have a tendency to show somatic pairing within the individual chromosome.

If the interpretation of these 'repeats' is correct, they must have carried identical genes at the time they were formed. Development on divergent lines would lead to these genes gradually taking on different functions in ontogeny; but it is to be assumed that these functions would be similar in the early stages. If this is so, one would expect that genes with similar phenotypic effects would often occur as doublets in close proximity in the same chromosome. A survey of the genes of *Drosophila*

melanogaster shows that there is in fact a considerable number of such cases, a number too great to be due to chance alone. The cases are most striking where the type of phenotypic effect is rare and the proximity close. Some examples are:

chlorotic—yellow (I, -0.1 and 0.0); also possibly *silver* (I, 0.1); only three other light body colours are known.

lozenge—*almondex* (I, 27.7 and 27.7 ±).

miniature—*dusky* (I, 36.1 and 36.2); the same doublet occurs also in *D. virilis*, *hydei* and *pseudo-obscura*.

tetraptera—*bithorax*—*bithoraxoid* (III, 51.3, 58.7 and 59.5); no other similar phenotype elsewhere in the whole complement.

pupal—*unexpanded* (II, 51 ± and 54 ±); only three other similar mutants known.

blistered—*balloon* (II, 107.3 and 107.4) } Only six other similar mutants are known; two of these (*blot-bloated*, II, 55 ± and 59 ±) form possibly another doublet.
blister—*Bubble* (III, 53.5 and 54 ±) }

achaste—*scute* (I, 0.0 + and 0.0 + +).

It appears that the increase of gene number by small adjacent duplications is reflected in the non-random distribution of genes in the chromosome complement.

A detailed analysis will be published elsewhere.

Department of Biometry, HANS GRÜNBERG.
University College,
London.
Oct. 12.

¹ Bridges, C. B., *J. Heredity*, 26 (1935).

Interaction between Cell Nucleus and Cytoplasm

DR. CURT STERN¹ has suggested a new and ingenious method of showing what he says has not been shown before, that the genes inside the resting nucleus act on the cell outside it. This action, however, is implied by everyday cytological observations, and is shown by many particular demonstrations in plants.

In all hybrid plants four cells are produced at meiosis with genetically different nuclei, and their genetic differences may be readily seen to express themselves before the nuclei come to divide, since many of these nuclei, on account of their genetic defects, never divide again. In general terms, we may say that this is one of the conditions of apomixis in most plants. It is precisely where the potential embryo-sac nucleus fails to divide that it is replaced by purely vegetative development of maternal tissue. This happens in the versatile apomictic species of *Hieracium*, *Artemisia*, and most probably in *Rubus*, *Rosa* and elsewhere. Similarly on the male side we find that, in triploids and other forms with irregular segregation at meiosis, a proportion of the pollen grains have usually died before their first mitosis could have taken place. That this failure is due to the individual properties of the pollen grain is shown by the selected population of pollen grains (in regard to chromosome number) which actually reaches division². Moreover, in two respects the pollen grains with different chromosome numbers often behave differently; first the length of the resting stage is different, so that in anthers taken at different times

we get a different sample of numbers², and secondly the pollen grains grow differently, so that the most unbalanced grains are disproportionately small³.

Two examples of the resting stage action of the chromosomes are of specific genetic importance. In the hybrid *Oenothera* species, the nucleus which, on account of its position, is expected to produce the embryo-sac, fails to divide if it has a certain female-defective genetic constitution. A nucleus of the opposite type (segregated from it at meiosis) then divides and takes on its function⁴. On the other hand, in *Rhago diacolor* pollen grains are formed not only with the haploid 8 chromosomes but also, owing to non-disjunction, with 5 and 7. Those with 7 come to division, those with 5 being genetically defective do not⁵. This indeed is a rule to which only one exception is known. In spite of the frequency with which defective pollen grains are known to be formed at meiosis, only once has such a pollen grain been observed to reach mitosis, and this pollen grain was in the exceptional state of having remained attached to a complementary sister grain of the meiotic tetrad⁶.

The evidence of the genetic individuality of cells raises another problem: How far is the choice of egg cell amongst the genetically different products of meiosis genetically determined, as it is in *Oenothera*? We know that the position of the embryo-sac cell is variable both where there are several mother cells, as in *Euphorbia*, and where there is only one, as in *Culcitium*⁷. We know also that the determination takes place after meiosis. We can therefore scarcely doubt that where important genetic differences distinguish the products of meiosis (as in triploids and structural hybrids), there will be a natural selection of favourable combinations in the egg cells. It remains to say that, where all the products of meiosis are not separated by cell walls (as in the *Lilium* and *Scilla* types of embryo-sac), it is impossible to decide from direct observation alone whether the egg-cell is not sometimes genetically instead of positionally determined. Breeding tests will be necessary. This is a question worth deciding, because selective fertilization in the wasp *Habrobracon*⁸ indicates that separate nuclei within a single cell are capable of showing by their movements a genetic individuality distinct from that of the cell as a whole.

That the interface or monomolecular film which separates the nucleus from the cytoplasm protects it from mere dispersion and violent external fluctuations is obvious. That in doing so it acts as a semi-permeable membrane may be shown in various ways⁹. But that it could utterly preclude chemical intercourse and therefore genetic action between the outside and the inside is contradicted every time the nucleus of an egg divides on the stimulus of a sperm; for if the nucleus cannot act on the cytoplasm outside, how can agents outside act on it, determining its division or its death?

C. D. DARLINGTON.

John Innes Horticultural Institution,
Merton, S.W.19. Oct. 30.

¹ NATURE, 140, 770 (1937).

² Darlington, C. D., "Chromosome Behaviour and Structural Hybridity in the Tradescantia", *J. Genet.*, 21, 207-286 (1929).

³ Darlington, C. D., "The External Mechanics of the Chromosomes, I-V", *Proc. Roy. Soc., B*, 121, 264-319 (1936).

⁴ Renner, O., "Heterogamie im weiblichen Geschlecht und Embryosackentwicklung bei den Oenotheren", *Z. Bot.*, 13, 609-621 (1921).

⁵ Belling, J., "The Origin of Chromosomal Mutations in *Ustilaria*", *J. Genet.*, 15, 245-266 (1925).

⁶ Schnerk, K., "Embryologie der Angiospermen", *Hb. Pflanzenanat.*, 10 (1926).

⁷ Whiting, F. W., "Sex Determination in Bees and Wasps", *J. Hered.*, 22, 263 (1931).

Germination of Resistant Spores of *Blastocladia Pringsheimii*

LETTERS¹ have appeared in NATURE relating to the germination of resistant spores, and in them certain suggestions have been put forward as to the needs of such spores. With these in mind, controlled conditions have been found suitable for the germination of the supposedly resistant resting spores of *Blastocladia Pringsheimii* Reinsch. The lack of success of former attempts to germinate them is perhaps due to the use of spores either immature or desiccated. A simple method has been found of storing the spores so that they may have time to mature and yet not become desiccated, or lost, meanwhile.

Blastocladia Pringsheimii Reinsch can be grown in the laboratory on small tomatoes in a jar of water. This fruit is particularly satisfactory, as the skin is thin and transparent and can easily be removed bearing the fungus *in situ*. Fruits were inoculated in April and again in May of this year, and as soon as young plants of the fungus were observed growing on them (with the mycelium ramifying within the pulp of the fruit and the sporangia emergent in the water) the fruits were well washed in fresh water daily to keep down the bacteria. In June the fungus, now bearing a good crop of resting spores, was stored: the fruit skin bearing the fungus was torn into pieces which naturally rolled up, the outer side within the roll, so that the fungus, with such spores as still remained attached, was conveniently held within the roll of skin. Small flasks were taken and plain agar agar poured in, to a depth of half an inch. When this had set, the rolls of skin were placed on the surface and more agar agar was poured upon them to a depth of half an inch, making one inch depth all told. These flasks were left in the laboratory until September, when the pieces of skin were taken out and unrolled, exposing the mature, but not desiccated, spores. These germinated in water in about 24 hours. Other pieces of fruit skin were unrolled from time to time throughout October and into November, and a good percentage of the spores always germinated readily in water within a day or so.

This is not the place in which to describe the phenomena of germination and the habit of the germings, an account of which will, it is hoped, appear shortly in a botanical journal.

ELIZABETH BLACKWELL.

Royal Holloway College,
Englefield Green,
London. Nov. 16.

¹ NATURE, 135, 306 (Feb. 23, 1935); 135, 546 (April 6, 1935); 139, 758 (May 1, 1937).

Photodynamic Action of Carcinogenic Agents

In a recent communication¹, we described the photosensitization of white mice by four carcinogenic agents. Since then we have sought other ways of demonstrating this reaction quickly, and have found that *Paramecium* is an excellent test object.

When benz-pyrene is ground up with tap water, and then spun for half an hour at 2,000 revs., a slightly opalescent liquid results containing not more than one part in 10,000. *Paramecia* will live in this in the dark for many days, but when placed in a glass cell, opaque to radiation of wave-length less than 3500 Å., in sunlight or in front of a mercury

vapour lamp, they die and cytolyse in a few minutes. In tap water without benz-pyrene they withstand this treatment indefinitely, provided that the effect of radiant heat is excluded. Exposure of the benz-pyrene in tap water to sunlight or to the mercury vapour lamp for long periods of time does not render it destructive to *Paramecia* when they are afterwards added and kept in the dark. The use of colour filters shows that radiations between 3500 Å. and 4100 Å. are effective.

Paramecia which have been subjected to benz-pyrene overnight and repeatedly washed in tap water by slow spinning, retain their photosensitivity.

Similar reactions occur when dibenzanthracene is used, except that the *Paramecia* require longer exposures to light than in the case of benz-pyrene.

We have not been able to sensitize red corpuscles, and this suggests that the *Paramecia* may be ingesting colloidal particles, especially since keeping them for a day or two in the benz-pyrene preparation in the dark greatly increases their sensitivity. Colloidal particles are present in the preparations made as described, but whether any of the benz-pyrene is in solution has not yet been ascertained.

Shale oil and coal tar likewise sensitize *Paramecia* when a dilute emulsion obtained by shaking with tap water is used.

These results therefore confirm our previous findings with white mice.

J. C. MOTTRAM.
I. DONIACH.

Mount Vernon Hospital,
Northwood,
Middlesex,
and
Radium Institute,
London.

NATURE, 140, 588 (Oct. 2, 1937).

Selection and Mental Factors

METHODS of 'factorizing' the correlation-matrix of a team of intelligence tests have been described in the last few years by Spearman, Kelley, Thurstone, Hotelling and others, and it is of interest to observe what the influence of selection (including natural selection) in the population tested is on the number and nature of the 'mental factors' thus arrived at. I have discovered that if a team of $n = p + q$ tests has been resolved into r general and n specific factors which are normalized and mutually orthogonal, and if the variances and covariances of p of these tests are changed by selection, then the team can still be analysed into r generals and n specifics, but, in addition, a certain number l of new group factors will appear which, however, run through the p directly selected tests only. Further, these $r + n + l$ factors will again be uncorrelated and normalized, but they are in general different from the original factors. Selection can thus be seen creating, destroying and changing factors.

A fuller account of this, together with a rigorous mathematical proof which Dr. Walter Ledermann has made for me, will be published as soon as possible.

GODFREY H. THOMSON.

University,
Edinburgh.
Nov. 1.

Conversion of β -Phellandrene into a Derivative of α -Phellandrene

RECENT observations^{1,2} of the co-existence of α - and β -phellandrenes in certain essential oils suggest a possible biogenetic relationship between these two terpenes. So far as we are aware no evidence of such an interconversion has been put forward although this might be anticipated from the apparently analogous conversion of β -pinene into α -pinene³. Since this lack of evidence may be due to the difficulty in detecting small quantities of one isomer in the presence of the other, it may be of interest to note that by condensation of maleic anhydride with l - β -phellandrene we have obtained a product which, from its melting point, mixed melting point and rotation, is apparently identical with the compound obtained from l - α -phellandrene³. The l - β -phellandrene employed was obtained from Canada balsam oil which has been shown to be free from α -phellandrene³.

Further evidence of the identity of the product is being sought and the mechanism of the reaction is being investigated. A full account of the experiments will be published elsewhere.

N. F. GOODWAY.
T. F. WEST.

Sir John Cass Institute,
Aldgate, E.C.3.
Oct. 23.

¹ Berry, Macbeth and Swanson, *J. Chem. Soc.*, 1444 (1937).

² Duncan, Sherwood and Short, *J. Soc. Chem. Ind.*, 50, 410T (1931).

³ Goodway and West, *J. Soc. Chem. Ind.* (In Press.)

⁴ Simonsen, "The Terpenes," 2, 169 (1932).

Free Radicals in Solution

WITHIN recent years numerous investigations have proved beyond doubt the existence of free alkyl and aryl radicals, which are formed in the gaseous phase by the thermal or photochemical decomposition of suitable organic molecules. More recently, Norrish and Bamford¹ have devoted their attention to the production of free alkyl radicals in solution and have shown that the alkyl radicals R and R' , formed by the photodecomposition of a ketone $RCOR'$, do not combine together, as in the gaseous phase, thus: $R + R' \rightarrow RR'$; $R + R \rightarrow RR$ and $R' + R' \rightarrow R'R'$, but mainly react with the solvent by abstraction of hydrogen with the formation of the simple hydrocarbons RH and $R'H$. Further, Walker and Wild² have studied the photodecomposition of diacetyl peroxide in solution (cyclohexane or ethyl alcohol) and have shown that more methane and less ethane is formed under these conditions than when the decomposition is effected in the absence of a solvent. This reaction would also appear to involve the production of free alkyl radicals, which again have the characteristic property of abstracting hydrogen from the solvent.

More than three years ago^{3,4}, attention was directed to certain classes of organic compounds, namely, the diazo hydroxides, the nitrosoacylarylamines, the arylazotriarylmethanes, and the diacyl peroxides, which in many of their reactions showed characteristics indicative of a non-ionic fission into free radicals and either nitrogen or carbon dioxide. Strong confirmatory evidence for this view was published a year ago⁵. These communications showed that, as with the alkyl radicals discussed by Norrish and Bamford, marked differences were to be found

between reactions of aryl radicals in the vapour phase and the corresponding reactions in solution, since in the latter case the free radical invariably reacted with the solvent molecules. The characteristics of the phenyl radical, formed in the presence of a solvent, may be summarized as follows: (a) the free radical is extremely reactive and able to interact with almost the first molecule of any type encountered; (b) polymerization to diphenyl does not take place; (c) reaction with all non-aromatic hydrogen-containing solvents results in the formation of benzene ($C_6H_5 \cdot + RH \rightarrow C_6H_6$); (d) reaction with all non-aromatic halogen-containing solvents results in the formation of a halogeno-benzene ($C_6H_5 \cdot + RHal \rightarrow C_6H_5Hal$); and (e) reaction with neutral aromatic liquids results in the formation of diphenyl derivatives in which the radical enters the aromatic nucleus at the *ortho* and/or *para* position with respect to any directing group which may be present.

A close similarity is thus revealed between the properties of alkyl radicals and those of aryl radicals in solution, and this correspondence gives striking support to the views originally put forward with reference to a non-ionic mechanism for certain reactions of the diazo hydroxides, the nitrosoacylarylamines, the arylazotriarylmethanes and the diacyl peroxides. In addition, various lines upon which the correspondence may be further extended immediately suggest themselves. The whole subject of reactions involving free radicals in solution will shortly be reviewed elsewhere.

University,
Manchester.

University,
Durham.
Oct. 22.

D. H. HEY.

W. A. WATERS.

¹ Norrish and Bamford, *NATURE*, **140**, 195 (1937).

² Walker and Wild, *J. Chem. Soc.*, 1132 (1937).

³ Grievé and Hey, *J. Chem. Soc.*, 1797 (1934).

⁴ Hey, *J. Chem. Soc.*, 1906 (1934).

⁵ Waters, *J. Chem. Soc.*, 113 (1937).

Behaviour of Cylinders of Inflammable Gas in a Fire

IN a letter to *NATURE*¹, my friend, Prof. K. C. Bailey, refers to the evidence I gave before the Free State Government's inquiry into the Pearse Street fire of October 5, 1936, where, owing to the failure of the water supply, three firemen lost their lives through carbon monoxide poisoning. Prof. Bailey's success in extinguishing a flame with a burst of gas from a high-pressure container will scarcely surprise anyone who has tried to light a gas jet (at only a few inches water-pressure) by holding a kindled match directly in its path. A draught of air, also, will extinguish a candle; though it might perhaps be expected to contribute to the combustion. A draught does not extinguish a blast-furnace.

Prof. Bailey's theory accounts for the two explosions that were heard by so many witnesses as being due (1) to the bursting of the coal-gas cylinder, and (2) to the chemical explosion of the atmosphere then constituted. Actually the evidence is perfectly clear that the coal-gas cylinder yielded plastically, bulging and dividing into a "pair of trousers". All the witnesses were shown this cylinder at the time of the inquiry.

Now the companion oxygen cylinder burst in such a manner as to blow part of its wall away; yet this rupture, though it must have been percussive in the highest degree, is apparently held to have been inaudible, and the discharge of 120 cubic feet of oxygen into a highly super-fuelled atmosphere is not, apparently, held to have been a similar cause of explosion.

There is no doubt, surely, that whatever cooling took place in the body of the liberated coal-gas, its periphery must quickly have attained ignition temperature in the burning inferno which Prof. Bailey postulates. Then it must have moved as a flame-mantled blimp towards and through the great ventage whence a glass roof had fallen in at some time before the two explosions.

22 Tree Root Walk,
Sheffield, 10.

Oct. 29.

OLIVER C. DE C. ELLIS.

¹ *NATURE*, **140**, 503 (Sept. 18, 1937).

Points from Foregoing Letters

THE synthesis of a complex carbohydrate from carbon dioxide and water in the presence of light, by means of a specially prepared nickel catalyst, is reported by Prof. E. C. C. Baly. The compound, when deposited on a surface, can be hydrolysed by diastase, and hence it may prove to be the parent of a starch-like substance.

Although the spectrum of nitrogen excited by electron bombardment varies greatly with pressure, R. Bernard finds that the spectral composition of auroras having a height of several hundred kilometres remains nearly constant. He considers, therefore, that the energy of the electrons and not pressure is the factor affecting the relative intensity of the radiations emitted.

M. G. E. Cosyns suggests that the anomalous distribution of cosmic rays coming from different directions (zenithal angles) may be explained by taking into account the diffusion of cosmic rays in air.

Dr. H. Grüneberg gives a list of pairs of mutations of the fruit fly, *Drosophila*, which have very nearly related characters, such as chlorotic-yellow, and points

out that the corresponding genes occur as doublets in close proximity within the same chromosome. He suggests that new genes arise by small adjacent duplications followed by differentiations.

Dr. C. D. Darlington states that the genetic action of chromosomes in the resting nucleus on the cell may be inferred from the rapid death of pollen grains and embryo sacs with defective chromosome complements in hybrid plants.

Further to the experiments on the sensitization by certain cancer-producing substances of mice by light, Dr. J. C. Mottram and Dr. I. Doniach find that paramesium is destroyed by benz-pyrene suspensions (1 in 10,000) in the presence of light of wave-length between 3500 Å. and 4100 Å., but not in the dark.

Dr. D. H. Hey and Dr. W. A. Waters point out that the reactions of free alkyl radicals produced photochemically in solution are exactly similar to those of free aryl radicals which they consider to be formed when certain classes of complex organic molecules decompose.

Research Items

Intoxicants in Sarawak

MR. E. BANKS, curator of the Sarawak Museum, has made a study of the customs and behaviour of Sarawak pagan tribes in relation to native alcoholic drinks (*Sarawak Mus. J.*, 4, 4). It is usual among the pagan tribes to offer visitors to the long house a drink made mainly from fermented rice and occasionally from sweet potato, sugar-cane, or even fruit. This helps to place hosts and guests at their ease and assist free discussion of intimate matters. The women, though brewing the liquor, drink sparingly, if at all, fearing intoxication. The Land Dayaks of Kuching and Salong prepare a very sweet yellow-brown drink from a reddish orange fruit. This contains 23 per cent alcohol. These people, who are much repressed, are abstemious from fear of intoxication. If they become intoxicated, they are never quarrelsome, but fall asleep. The Sea Dayaks, or Iban, brew a sweet and milky drink with about 20 per cent alcohol; but they drink rarely and are singularly sober. This, however, is due largely to thrift and lack of opportunity; and European drinks, if free, are absorbed in large quantities by both men and women without noticeable effect. Drink plays a very large part in the life of both Kayan and Kenyah, no birth, death, or marriage ceremonies being complete without a liberal supply of drink for all, including visitors. The same applies to agricultural ceremonial. Cooked rice mixed with water is the mainstay of the drink, which is brewed by women, but with great uncertainty as to what the product will be, both in strength and flavour. Fruit, berries and a yeast are added to the rice liquid, the alcoholic content in samples tested ranging from 18 to 23 per cent. Strong alcohol is obtained from this liquor by distillation. There is considerable etiquette in drinking, and the ritual is prominent in their customs. They drink frequently and jovially, and hold their drink well. The Kelabit and Murut, on the other hand, living farther north and at a considerably greater altitude—3,000–4,000 ft. where the nights are cold—are mighty drinkers; but whereas the Kelabit shows no ill-effects, the Murut is drinking himself out of existence.

Biological Action of X- and γ -Rays

THE keynote to "Some Quantitative Aspects of the Biological Action of X- and γ -Rays" by C. M. Scott (Med. Res. Coun. Special Report Series No. 223. London: H.M. Stationery Office, 1937. Pp. 99. 1s. 6d.) is the term quantitative, for the author has summarized and criticized the work of radiologists where quantitative, rather than qualitative, results have been claimed. All the important effects of X- and γ -rays upon living tissues come under consideration in Part 1—some at length, others more briefly. The author's chief aim is to direct attention to our scanty knowledge of the nature of the primary action of these rays, at the same time maintaining that this action is largely exerted on the nucleus of the cell and thereby on the cell processes that control growth. Part 2 contains detailed description of the author's experimental work upon the effects of X-rays and radium on the isolated frog's heart and upon the eggs of *Calliphora erythrocephala*. The

general plan of these experiments might well serve as a model for others, showing as they do the essential features of quantitative work. Mr. Scott's conclusions will not be accepted by all, but they will be treated with the respect that their sincerity warrants, and his views generally will prove a stimulant to research.

The Protein of Yellow Enzyme

THE importance of the 'yellow enzyme' is considerable: its identification as lactoflavin-5'-phosphoric acid, of known structure, coupled with a specific protein, has been one of the outstanding achievements in the laboratory of recent years. A successful attempt has now been made by Prof. Richard Kuhn and P. Desnuelle of Heidelberg to establish the nature of the protein (*Berichte*, 1907; 1937). Normally such an analysis requires very considerable quantities of material, whereas the yellow enzyme is known in milligrams rather than in grams. The absorption process of Weygand has enabled somewhat larger quantities of the pure yellow enzyme to be prepared so that the amino acids obtained on acid hydrolysis of the protein could be estimated quantitatively. To do this the latest microbiological technique has been applied, colour reactions for the individual amino acids have been used to estimate them photometrically, and the hexone bases were separated by electrodialysis. The achievement is a striking one and an outstanding example of the delicacy and the advantage of this new technique. So far, no particular variation from the known proteins is shown either in the nature or the quantity of the amino acids—65 per cent of the nitrogen has been identified. The hexone bases are of importance, since the protein is attached through basic groups to the rest of the molecule in two places. It may be of significance that the total of histidine, arginine and lysine is the same as in the protein of hemoglobin, but their relative proportions are entirely different.

Insects and Mites in Stored Grain

THE attention of entomologists is directed to Miscellaneous Publications 258 (July 1937) of the United States Department of Agriculture, written by Messrs. R. T. Cotton and N. E. Good. This 80-page brochure lists the insects and mites associated with stored grain and cereal products from all parts of the world. Under each species is given its geographical range, habitat, food habits, its parasites and predators together with its relative importance as a pest: wherever necessary, references to literature are also given. The various invaders of grain, etc., are classified according to their status or, in other words, whether they are of major or minor importance or only incidental pests. They are also classified taxonomically, which facilitates easy reference from that point of view.

Antarctic Vegetation

AN interesting geographical extension of the scanty flora of the Antarctic regions is noted in an article in the *Polar Record* of July on the work of the R.R.S. *Discovery II*. Until recently, the only two flowering plants, a grass (*Deschampsia antarctica*)

and a small caryophyllaceous plant (*Colobanthus* sp.), recorded were poor and stunted specimens from the South Shetlands and the north-western part of Graham Land. These two species are now recorded from Signy Island which lies on the south of Coronation Island, the largest of the South Orkney group. The previous search by the *Scotia* expedition for these plants on Laurie Island, another island of the group, had proved fruitless. The discovery of a liverwort on Signy Island is another extension of geographical distribution in the Antarctic.

Origin of Lead Ores

THIS problem has been recently discussed in the light of atomic weight evidence by Arthur Holmes (*Econ. Geol.*, 763-782; 1937). The lead dispersed through rocks in minute quantities is called rock-lead; it consists partly of common lead, originally present in the rock material, and partly radiogenic lead, generated in the same rock material by the disintegration of uranium and thorium during geological time (taken as about 2,000 million years). From the available determinations of lead, uranium and thorium in various types of rocks, it is shown: (a) that the average atomic weight of granitic rock-lead should have decreased progressively during geological time from 207.21 at the beginning to 207.14 at the present day; (b) that the average atomic weight of basaltic rock-lead should have similarly decreased from 207.21 to 207.10. The atomic weight of rock-lead concentrated in cotunnite from the 1906 magma of Vesuvius is 207.05, a result which confirms the inference that rock-lead has an atomic weight significantly lower than that of common lead. The atomic weight of common lead, that is, the lead concentrated in ore-deposits, is found to be 207.21 ± 0.01 and—as far back as 1,300 million years—to be independent of the geological age of the ore. It follows that such ore-lead cannot have been derived from granitic or basaltic rocks, or from the sediments formed from such rocks, and that it has no genetic connexion with acid or basic magmas. Ore-lead must, therefore, have ascended from depths below the sialic and basaltic layers of the earth's crust. The view of the late J. W. Gregory that "the source of the ores appears to lie in a zone deeper than that of the ordinary igneous rocks" is thus largely confirmed, so far as lead ores are concerned. The data for peridotites are too few to justify the extension of this generalization to ultrabasic rocks and magmas.

Earthquakes off the Coast of Northern California

THE coastal portion of California is one of the most interesting earthquake regions in the world. This is due to the connexion of many of its earthquakes with the remarkable San Andreas fault that traverses the whole length of the State. As Prof. Byerly points out in a valuable paper (*Bull. Seis. Soc. of America*, 27, 73-96; 1937), recent earthquakes cluster in three segments of the fault, a northern one in the counties of Del Norte and Humboldt, a central one from the Golden Gate to San Luis Obispo county, and a southern one in the Imperial Valley; while the regions of great displacement, such as that in 1906, occupy the intervening portions. The frequent occurrence of earthquakes with their centres at sea off Humboldt County has led to the suggestion that there may be another active portion along a linear extension of the fault beyond Punta Arenas. The greater part of Prof. Byerly's paper is devoted to the

determination by two methods of the epicentres of three earthquakes in 1934, 1935 and 1936. The positions obtained by the methods are in fair agreement. As, however, the distances of the points nearest the continued fault-line are about 23, 15 and 45 miles, the author concludes that there is no real connexion of the earthquakes with movements along the San Andreas fault.

Carbonization of Coal at Low Temperatures

THE Department of Scientific and Industrial Research has published a report issued by the Director of Fuel Research of a test made on the plant of the National Coke and Oil Co., Ltd., at Erith, for carbonizing coal at low temperatures. The process consists in carbonizing a paste of about equal parts of coal and oil in rotary cylindrical retorts, the oil produced by the plant itself serving as vehicle, after removal of spirit. About 15 cwt. of coke was obtained per ton, ranging in size from 4 in. downwards. It was dense, easily ignitable and easy to burn in open fires. About 10 cwt. of this was less than $\frac{1}{2}$ in. and was crushed and briquetted. 8.9 gallons of refined mixed spirit was obtained per ton of coal and, in addition, oil suitable for Diesel engines. Both caking and non-caking coals were carbonized in the plant, the retorts of which were externally heated, and for this purpose all the gas produced in the process is required.

Infra-red Absorption of Hydroxy Compounds near 3μ

MANY compounds containing the hydroxyl group have a sharp absorption band at 2.75μ and another wider band about 3μ , attributed to associated molecules. This association band diminishes on dilution with a non-polar solvent and on increasing temperature. An investigation of these bands for phenol and certain aliphatic and aromatic alcohols in solutions of carbon tetrachloride and other solvents is reported by Drs. J. J. Fox and A. E. Martin (*Proc. Roy. Soc., A*, 162, 419; 1937) and the results are characterized by the same interest, thoroughness and comprehensive treatment which has been a distinctive feature of previous infra-red work carried out in the Government Laboratory. Phenol has been investigated in several solvents, and the intensity of its association band is proportional to the number of molecules not contributing to the shorter wave length band. Equilibrium between single and double molecules is set up at moderate concentrations, and the forces acting between such molecules are considered on the basis of London's theory of inter-molecular forces. With chloroform as solvent, the intensity of the association band is reduced to about half the value with carbon tetrachloride. For both solvents association is reduced by increased molecular complexity in the series, PhOH , PhCH_2OH , Ph_2CHOH , Ph_3COH . Factors affecting the locations and intensities of the bands in these compounds are discussed. The effects shown by normal and tertiary butyl alcohols are compared and data for stearyl and cetyl alcohols are given. Influence of structure on the CH vibration bands has also been studied. Aliphatic CH bands for CH , CH_2 , and CH_3 groups have constant intensity for the CH linking in each molecule and it is distributed among the one, two, or three CH linkings attributed respectively to each group; whilst in aromatic alcohols the positions of the CH bands remain unaltered, but relative intensities are not always retained.

An International Conference on the Theory of Probability

THE Faculty of Science, University of Geneva, organizes periodical international conferences on various branches of mathematics. A special committee presided over by Prof. R. Wavre, chooses and invites lecturers. Visitors are also welcomed at these conferences, and invited to take part in the discussions.

This year it was the turn of the theory of probability. The Conference lasted the whole week, October 11-15. It was opened by Prof. R. Wavre and then addressed by its chairman, Prof. M. Fréchet, of the Sorbonne, who outlined the trends and conflicting tendencies in the recent history of the theory of probability. Next, fifteen other papers on various subjects and various modalities of the probability theory were read and discussed in the presence of fifty to one hundred listeners. It is hoped that the contents of the papers presented at the Conference, and also those of the authors who were prevented from attending, will be published soon, as separate numbers of the series "Actualités Scientifiques" (Hermann et Cie., Paris).

The purpose of these conferences is to mark and sum up the latest achievements in the particular branch of mathematics under discussion. Therefore the general tendency in papers presented was not necessarily to state and prove some particular theorems, but rather to describe the state of various theories, without going into details of proofs. It need scarcely be said that this contributed greatly to the interest of the proceedings, and it was possible to build up a general outlook on what is being achieved and what is being aimed at in the theory of probability. Below we give a subdivision which suggested itself to us. It will be realized that any such classification is only approximate and must be influenced by personal opinions. Therefore, while indicating the names of the authors of papers which seem to belong to one or the other of the described directions, we wish to emphasize that we ourselves could not recommend this classification as a totally objective one.

First of all we may mention three different directions of work concerning the very foundation of the theory, that is, the definition of probability. As is the case with many other mathematical sciences, the theory of probability is designed to provide a model of certain processes in the outside world. Here we have the first point of subdivision. There are theories aiming at representing primarily (a) the machinery of frequencies in repeated trials and (b) the changes in the state of mind of the observers. Theories of the first kind have for their object to use probabilities p_1, \dots, p_k of some events, supposed to be known, in order to calculate the probabilities P_1, P_2, \dots, P_m of some other events, but are totally indifferent as to how the values of p_1, p_2, \dots, p_k can be obtained in practice. On the other hand, this is the very question which seems to be central in the other theory (B. de Finetti).

The theories of group (a) (W. Feller, M. Fréchet, J. Steffensen, A. Wald) are again subdivided. First of all there are what could be called the modernized classical theories, in which the probability is considered as an additive or an absolutely additive set

function. Next there are theories where the probability is being defined as a limit of a relative frequency, the existence of which is being postulated. All these directions were represented at the Conference, and there were lively discussions. The absence of F. P. Cantelli and that of R. v. Mises, who are important representatives of the directions mentioned and had promised to read papers, was much regretted.

Most of the work which did not directly concern the foundations was on the modernized classical theory. Here again several points of subdivision suggest themselves. One category represents the work on the perfection of the theory either by bringing in the mathematical accuracy in a field already more or less treated or by deducing new facts. Such were the papers on a new theorem concerning the law of big numbers (H. Cramér), on the probability problems in mechanics (E. Hopf), on the arithmetic of probability laws (P. Lévy), and on the conception of independence (H. Steinhaus). A paper promised by A. Wintner was greatly missed by the Conference.

The original programme of the Conference included a number of papers on what could be called random curves, which is a new and most important branch of the theory of probability connected with that of Markoff chains. It was much regretted that the respective authors (S. Bernstein, V. Glivenko, A. Kolmogoroff, V. Romanovsky and E. Slutski) were not able to be present, but it is hoped that their work will be published with the others. The only paper in this direction, on the chains with complete connexion, was given by O. Onicescu.

Further work concerned the applications. An extremely interesting paper was read by W. Heisenberg on the probability statements in the quantum theory of waves. His most remarkable conclusion was that modern physics seems to require a new branch of mathematics involving the conception of an absolute minimum of distance. G. Pólya discussed certain simple schemes of random experiments which, by some ingenious passages to the limit, lead to partial differential equations and distribution functions applicable in physics and engineering. On similar lines also was the paper by B. Hostinský. These were really papers solving problems of mathematical statistics as defined by Borel: to find a system of random experiments (by drawing balls or tossing coins) such that the most probable frequencies of their results would approach closely those observed in some field of application.

Papers of a still more statistical character were given by E. L. Dodd, on the estimates of regression coefficients based on the principle of maximum likelihood, by J. Neyman, on the theory of statistical estimation conceived as a problem in classical probability, and by N. Obrechkoff on the cases of convergence of the Charlier series. We regretted the absence of C. Jordan, who promised a paper on correlation.

The programme of the Conference included receptions and parties given by the Société de Physique et d'Histoire Naturelle, by Prof. Kurt Meyer, by the Faculté des Sciences and by the organizing committee of the Conference. During these receptions

we were cordially welcomed by Prof. G. Tiercy, dean of the Faculté des Sciences, and by Prof. F. Chodat, acting for the president of the Société de Physique et d'Histoire Naturelle. The receptions were much enjoyed, and offered a precious opportunity of personal contacts and exchange of opinions and criticisms in private. When we were driven into the Jura and, having turned a corner, saw the Lake of Geneva far below the road, and in front of us, behind the Lake, the glittering tops of the Alps, the exclamations of delight were mixed with unfinished sentences concerning point sets, measure, Bayes, etc. The

cordiality of the hosts, among whom were Profs. H. Fehr, D. Mirimanoff, G. de Rham, and R. Wavre, culminated at the closing dinner on Friday night, after which the guests departed, carrying with them happy memories of the Conference and a feeling of gratitude to the hosts and hopes of future similar occasions.

It was announced that another conference on the theory of probability will be held soon in Geneva, and will deal more especially with problems of various applications.

E. L. DODD.

J. NEYMAN.

The Birch 'Forests' of Greenland

By Dr. Nicholas Polunin, Department of Botany, University of Oxford

DURING the past summer of general botanical work in the Julianehaab district—climatically the most favourable part of Greenland—special attention has been paid to the history and present-day ecology of the oft-mentioned but little known Greenland 'tree' birch (*Betula pubescens* sens. lat.).

In 1933 I was able to show¹ that in Lapland the roots of the nearly related (perhaps conspecific) *B. odorata* Bechst. are able to conduct water actively through at least half a metre of hard-frozen soil, and moreover that where the roots are unable to extend below the frozen surface layer, this generally dominant plant is absent or at least fails to attain proper 'tree' form². Much the same seems to be true of the Greenland *B. pubescens* which, however, scarcely attains the form or proportions of a real tree. Its 'forests', which are generally confined to the most sheltered fjord-head regions, consist for the most part of straggly bushes 2-4 metres in height. Moreover this scrub, at least in the district visited, appears almost always to be interrupted at more or less frequent intervals by patches of lower *Salices* or dry lichen or herb associations—most often due to biotic disturbance but sometimes, it seems, to natural edaphic or other environmental conditions. Occasionally an individual birch will be found reaching a height of 5½ metres or a little more, while the maximum stem diameter observed was 25 centimetres. These larger trunks and indeed almost all the 'trees' are gnarled and prostrate or obliquely ascending near the butts³, being often twice as long as they are high and generally growing several from a stool and away from the direction of the worst "foehns".

These peculiar winds, descending with gale force from the lofty ice-cap, may be so warm and lasting as to melt all the snow even in the dead of winter and kill whole patches of the shallow-rooted *Empetrum* and other 'heaths' by desiccation when the soil is frozen near the surface and water cannot be absorbed to make good that which is lost by transpiration from the aerial parts. The result is that the ground vegetation in many places consists largely of cryptogams which are temporarily able to withstand almost complete desiccation. But the dominant birches—and probably also the *Salices*—have roots going down far below the deepest level (60 cm.) to which, so far as I have been able to determine by digging in early summer and questioning the natives,

the soil is liable to be frozen in the areas of the largest birches in winter. (During the first week of August I was unable to find any ground-ice or temperatures below 2-3° C. even down to depths of nearly 2 metres in the bogs in Tunugdliarfik Fjord.)

There can be no reasonable doubt that the 'trees' are, as in northern Lapland⁴, limited to areas where the soil is only frozen superficially in winter, and that they can withstand the extremely inimical springtime foehns—which may cause the buds to swell and sometimes burst into leaf, yet even small twigs are rarely killed—only by absorbing water from lower levels and conducting it up through the frozen layers; for rootlets are to be found almost everywhere extending to 1-2 metres, at which depth sandy soil is in summer almost as warm as near the surface. Such regions, with relatively warm or at least unfrozen conditions of subsoil throughout the year and supporting tree or tall bush growth over considerable areas, are by the biologist to be classed as Subarctic rather than truly Arctic in type; for in the Arctic the soil is permanently frozen to a great depth, only the surface layer thawing out in summer.

The presence or absence of a permanently frozen subsoil, which itself depends upon local physiographic as well as general climatic conditions, may largely determine the northern limit of tree growth in the world, at least in regions of relatively oceanic climate; it may perhaps also afford a convenient standard for distinguishing between the Arctic and Subarctic where latitude and other criteria fail.

The theory propounded by Ostenfeld⁵ but already strongly refuted by Porsild⁶ that the 'tree' birch was introduced to Greenland from Iceland by the Nordic colonists of the tenth century is quite untenable on geobotanical, sub-fossil⁷ and even written historical grounds. The Greenland 'forests', the dominants of which often approach 100 years in age and harbour junipers 200-300 or even more years old⁸, appear instead to be relics of a more genial postglacial warm period that probably lasted until about 2,000 years ago, according to verbal information from Prof. Knud Jessen and Dr. J. Iversen of Copenhagen, who have each carried out independent investigations on the sub-fossil strata of different parts of south-west Greenland. These authorities and Dr. M. P. Porsild, who has spent most of the last thirty-one years in Greenland as director of the Danish Arctic Research

Station on Disco Island, moreover agree with me that there is no real evidence, either archaeological or otherwise, for the popularly supposed serious deterioration of climate since the time of the Nordic colonization.

What was probably the strongest suggestion of such a change resulted from the discovery of the coffins of some buried Norsemen permeated by roots of plants but all frozen in summer⁹; but that was only in one place far out on the exposed ocean coast and in a bad year and other quite unusual circumstances, as the late Fridtjof Nansen quickly pointed out in objecting to this suggestion; moreover, the presence or absence of frozen soil conditions depends on a number of factors of which aerial temperature is only one¹⁰. That the climate may have become somewhat drier and a very little cooler since the advent of the Norsemen seems quite possible, and indeed just around Eric the Red's estate at Qagssiarssuk where the birch 'trees' were extensively cleared by the Norsemen they have failed to reappear even in the 400-500 years since the dying out of the colony. But there is no evidence of a change great enough to have been, at the very most, more than one factor contributing in some degree to the downfall of their once flourishing civilization.

Thus the peat deposits show no signs of any important change in the summer temperature since long before the advent of the Norsemen¹¹, while even if the climate has become drier the conditions are still damp enough to support over large areas in this district luxuriant grassy herb communities that afford some of the best summer pasturage I have ever seen! Moreover the outlawed Eric, in what has wittily been termed 'the first real-estate venture', called the country *Groenaland* 'the green land' merely in order that he might the more easily attract colonists from Iceland¹²—which suggests that the notoriously inhospitable aspect of the coast is no mere present-day phenomenon. Finally, and perhaps most significantly of all, the tree and bush communities in some places

show to this day what is with little doubt the same delimitation as they were given by cutting by the Norsemen and grazing by their domestic animals. It is inconceivable that the extremely fine equilibrium existing between these 'higher' communities on one hand and the luxuriant alternating patches of grass and herbs on the other could have been maintained in the face of any appreciable climatic vagaries, much less a profound change; while even if this remarkable community delimitation can only with fair certainty be stated to date from the final disappearance of the Norsemen, it seems highly probable that it is the result of long lasting biotic impress and hence dates from well before that time. Even the temperature of the earlier warm period, which presumably corresponded to the sub-boreal of Europe, may have been only slightly above that of the present day, for no evidence has yet been found of the occurrence in Greenland in post-glacial times of any plant formation or species which does not live there now.

Since the above was written Prof. Jessen has informed me (1) that he has found plentiful fruits of *Betula pubescens* s.l. in peat layers from south-west Greenland that were laid down long before the advent of the Norsemen, which finally proves that the plant is indigenous; and (2) that from the experience of many deep borings which he made in the summer of 1926 in the Julianehaab district it was obvious that ice was quite absent from the ground.

⁹ NATURE, 132, 313 (1933).

¹⁰ Oxford Univ. D.Phil. Dissert. 1935 (Abstract published at the Clarendon Press).

¹¹ cf. Rosenvinge, *Medd. om Grønl.*, 15, 135 (1896).

¹² Polunin, *J. Ecol.*, 24, 2 (1936).

¹³ *Kgl. Danske Vidensk. Selsk. Biol. Medd.*, 8, (3), 17 (1926).

¹⁴ *Medd. om Grønl.*, 92, (1), 57 (1932).

¹⁵ Trapnell, *J. Ecol.*, 21, (2), 311 (1933).

¹⁶ cf. Rosenvinge, *Medd. om Grønl.*, 15, 135 (1896).

¹⁷ Norlund, *Medd. om Grønl.*, 67, 237 (1924).

¹⁸ cf. Nansen, *Afh. utgitt av Det Norske Vidensk.-Akad. i Oslo*, nr. 3 (1926).

¹⁹ Iversen, *Medd. fra Dansk Geol. Forening*, 8, 4 (1934).

²⁰ cf. Jónsson, "Greenland", 2, 333 (1928).

The Cyclol Hypothesis and the 'Globular' Proteins

DR. D. M. WRINCH has extended the cyclol theory of protein structure to account for the existence of space-enclosing or 'globular' molecules (*Proc. Roy. Soc., A*, 161, 505; 1937).

The cyclol theory showed that a molecular fabric could be formed on the basis of the polypeptide theory by assuming that the peptides did not lie fully extended but underwent rotation at the bonds to form hexagonal structures. A series of these containing $2, 6, 18 \dots 18 + 24n$ residues can form closed systems of regular geometrical form with three-way symmetry. The second member of this series, called 'cyclol 6', forms the basis of the 'cyclol fabric'. Other members of the series could, if it were desired, be used as the basis of geometrically regular two-dimensional fabrics.

Any theory of the structure of three-dimensional molecules containing several thousand atoms must take into account the mathematical possibilities of distributing these in space in such a way that the resulting model will account for the known chemical

and physical properties of the substance in question. The cyclol fabric can be folded along certain well-defined lines to form space-enclosing models of regular geometrical form, without violating any of the fundamental requirements of the cyclol fabric; for example, truncated tetrahedra can be formed by bending round the cyclol fabric without any distortion of the cyclol net. The truncated tetrahedra form a series which contain $72, 288 \dots 72n^2$ residues. These tetrahedral models, like the original 'cyclol 6', allow for polymerization, so that one, two or more of them can be brought together by apposition of their plane faces to form a series of polymers.

The model containing 288 residues is of great interest for it would have a molecular weight approximating to 35,000, which Svedberg has found as a basic number for the molecular weights of globular proteins. For example, insulin and egg albumin (which on the cyclol theory consist of 288 residues per molecule) have molecular weights of approximately 35,000, while various other proteins have molecular

weights approximating to $35,000 \times 1, 2, 4$ or 8 . Many of these under conditions of varying pH can break up reversibly into segments which are simple submultiples of the original molecular weight. It is also interesting to notice that Bergmann and Niemann (since the above prediction) state that the chemical analysis of egg albumin enables them to deduce that this molecule consists of exactly 288 residues (*J. Biol. Chem.*, 118, 301; 1937).

A series of models based on the truncated tetrahedron formed from the cyclol fabric and simple polymers of this, thus accounts satisfactorily for the type of molecular weight series found in some 'globular' proteins, namely, simple multiples of a basic unit of 35,000.

The Problem of Leisure

WE have not infrequently insisted upon the problem of leisure as one of growing importance, and have emphasized the inevitable effects of the application of science to industrial processes—effects which have been put under the heading of 'technological unemployment'. As the machine lessens the volume of toil required from men and women, our social organization must be adapted to give the new services which will be demanded of it. Already the move towards a reduction in working hours is apparent and must bring with it a corresponding increase in the hours of leisure. How will that leisure be used?

The widespread interest in the possible answers to that question was shown on November 18 when more than two hundred bodies were represented at a conference arranged by the National Institute of Industrial Psychology and the British Institute of Adult Education. The problem of leisure was the problem which attracted that very large audience, and it was finally decided to set up a committee representative of bodies willing to co-operate in the carrying out of what might be called our first survey of leisure. It will consist in the first place of an investigation of the opportunities for leisure, for, clearly, any such survey will fail in its purpose if it neglect factors such as housing conditions, transport facilities, the extent to which poverty debars from participation in recreation, and other similar considerations.

The purpose of any report which may be drawn up as a result of the investigation will not be to interfere with or supplant the work of bodies already engaged in work affecting leisure activities, but to assist them.

The survey will be on broad lines and will recognize that, while many leisure pursuits require organization, resentment would arise from anything suggestive of coercion, patronage or intrusion on individual privacy.

The present suggestion is that the investigators should base their report upon a first-hand examination of the facts in certain districts which would be selected so far as possible as being typical of prevalent conditions. The following list of districts has been compiled as one where investigations would doubtless be most profitable: a town of varied districts where the factories, dwellings and recreational facilities are within easy reach of one another; a district where the workers' dwellings and their recreational facilities are distant from their work; a

developing district where the conditions of work and leisure have been planned, but where the population has grown up without local civic conditions; a developing, but unplanned, district; a district where varied industries are scattered amid rural surroundings; and a popular holiday resort, with special reference to the increasing extension of the holiday season beyond the summer months. The increase of holidays with pay, the raising of the age of entry, and the lowering of the age of exit, from industry and the incidence of shift work are all factors which must be taken into consideration as the investigation proceeds. Duplication of effort will be avoided and investigators will be asked to distinguish carefully between the collection of fact, the collection of opinion and their own conclusions.

Science News a Century Ago

Anniversary Meeting of the Royal Society

At the anniversary meeting of the Royal Society on November 30, 1837, the president, H.R.H. the Duke of Sussex, being prevented from attending by illness, his address was read by Francis Baily. In the report of the Council for the year, it was said: "The principal business of public interest which has occupied the attention of the Council relates to the extension of accurate magnetical and meteorological observations in different parts of the world."

"A communication having been made by Lieut. William Denison, of the Royal Engineers, of a proposal from General Mulcaster, Inspector-General of Fortifications, that the officers of engineers generally should be employed, under the direction of the Royal Society, in promoting the advancement of science, by carrying on connected series of observations relating to Natural History, Meteorology, Magnetism and other branches of physical science, and suggesting an application to Government for a grant of funds necessary for effecting so desirable an object; a Committee was appointed to consider the proposed measure, and of the means to carry into effect the recommendations contained in the letter of Baron Von Humboldt addressed in April last to the President. Conformably with the report the Council fixed on the ten following places, namely, Gibraltar, Corfu, Ceylon, Hobart Town, Jamaica, Barbados, Newfoundland, Toronto, Bagdad and the Cape of Good Hope as being the most eligible for carrying on magnetic observations . . . these places being permanent stations where officers of engineers and clerks are always to be found." A grant of £500 for instruments was afterwards obtained from the Government.

Award of Two Copley Medals

THE report of the Council also referred to the award of the various medals, two Copley Medals being awarded on this occasion, one to A. C. Becquerel and the other to J. F. Daniell. The award to Becquerel was "particularly for the production of crystals of Metallic Sulphurets and of Sulphur; by the long-continued action of electricity of very low tension. In the memoirs particularly referred to by the Council he has especially in view to explain, by the agency of electricity of very low tension, continued for an indefinite time, the occurrence of crystallised substances in mineral veins. By his work Mr.

Becquerel has thus opened up a new field for inquiry and discovery, in which he has himself gathered the first fruits, but which still offers to future labourers the prospect of an abundant harvest of knowledge as regards both the recomposition of crystallised bodies and also the processes which may have been employed by nature in the production of such bodies in the mineral kingdom."

Antoine César Becquerel was born on March 7, 1788 and died on January 18, 1878. After passing through the École Polytechnique, he served in the French army for a short time but soon quitted the service and devoted himself to scientific research. He was one of the founders of electro-chemistry. He was admitted a member of the Paris Academy of Sciences in 1829. Becquerel was appointed to the chair of physics in the Musée d'histoire naturelle in 1837 and this post he held until his death. He was succeeded in the chair first by his son Alexander Edmond Becquerel (1820-91), and then by his grandson Antoine-Henri Becquerel (1832-1908), the discoverer of radioactivity. A statue of Antoine César Becquerel was unveiled at his birthplace, Châtillon-sur-Loire (Loiret), in 1882.

Level of the Caspian Sea

IN a letter written from Dorpat on December 1, 1837, to Alexander von Humboldt, Friedrich von Struve, the famous astronomer, referring to the geodetical operations carried out by the order of the Emperor of Russia to determine the level of the Caspian Sea, said, "Our travellers G. von Fuss, Sabler and Sawitsch happily completed their laborious task on the 23rd of October. I have just received the reports and a copy of the journals from the village of Tschernoi-Rynof, near the station of Kolpitschja (on the road from Kisljar to Astrachan) dispatched on the 31st of October (N.S.). The rapid progress of the operations made it impossible to keep up the calculations at the same pace. Our travellers, however, have gone through the whole and are able by a preliminary calculation to state at once the following result as very near the truth:—*that the Caspian Sea is really considerably lower than the Euxine: viz., 101.2 Russian = 94.9 Paris feet.* This preliminary result is warranted to be correct within five feet" (*Athenæum*, Dec. 23, 1837).

University Events

BIRMINGHAM.—At a special meeting of the Court of Governors held on November 18 the pro-chancellor (Mr. Walter Barrow) presiding, the resignation of the vice-chancellor (Sir Charles Grant Robertson) was accepted, the resignation to take effect on September 30, 1938. The appointment of the vice-chancellor has hitherto been made by the Crown and no age limit was attached, but by an alteration of the statutes (in 1927), future appointments were to be made by the Court and an age limit of sixty-five years was fixed. The pro-chancellor explained that, on approaching this age, Sir Charles voluntarily placed the continuance of his appointment in the hands of the Council, who expressed the wish that he should remain in office until the completion of the new Central Hospital and Medical School, which owed so much to his vision and patient work. As it is expected that both buildings will be finished by next summer,

Sir Charles desired that he should retire on September 30 next, when he would have reached the age of sixty-nine years.

The Court then proceeded, for the first time, to elect a new vice-chancellor, and the pro-chancellor proposed, on behalf of the Council, the name of Dr. Raymond E. Priestley, giving an outline of his remarkable achievements. The proposition was seconded by the vice-principal (Prof. J. G. Smith) and warmly supported by Sir Gilbert Barling and (from personal knowledge) by Mr. J. H. Reynolds, Prof. M. L. Oliphant and Prof. Lees. The Court unanimously elected Dr. Priestley.

After the meeting of the Court a portrait of Sir Charles Grant Robertson (by Mr. James Gunn), presented to the University by 225 subscribers, was unveiled in the Great Hall by the wife of the pro-chancellor.

Earlier in the afternoon Mr. T. E. Harvey, M.P. (Combined Universities), had formally opened St. Francis' Hall, a chapel given to the University by Mr. and Mrs. Edward Cadbury for the use of the undergraduates.

CAMBRIDGE.—A research studentship at Emmanuel College will be awarded in July 1938. Preference will be given to Candidates who have already completed one but not more than two years of research. The studentship has a maximum annual value of £150, is awarded and normally held for two years, but may be renewed for a third. The studentship is not tenable by a woman or by a member of the University of Cambridge. Further information can be obtained from the Master, Emmanuel College, Cambridge.

An appointment to a research studentship at Christ's College will be made at the end of July 1938. Candidates must be men who will have graduated before October 1, 1938, at some university other than Cambridge, and who have not commenced residence in Cambridge at the time of election. The studentship will be normally held for two years, but it may be prolonged for a third year in exceptional circumstances. It is of annual value not exceeding £200. Further information can be obtained from the Master, Christ's College, Cambridge.

LEEDS.—Dr. J. W. Orr, lecturer in experimental pathology, was elected to the post of reader. Dr. Orr is also assistant director of cancer research.

The following appointments have been made: Dr. H. G. Garland as clinical lecturer in medicine and honorary demonstrator in medical pathology; Dr. J. A. Price as honorary demonstrator in medicine; N. Lissimore as honorary demonstrator in pathology; F. R. W. Hemsley and I. J. Keidan as honorary demonstrators in anatomy; Miss Florence O. Bell as research assistant in textile physics.

LONDON.—Prof. A. J. Allmand has been appointed as from August 1, 1938, to the Daniell chair of chemistry tenable at King's College. Since 1919 he has held the University chair of chemistry at that College.

The following have been appointed University readers: Dr. L. P. Garrod (St. Bartholomew's Hospital Medical College) in bacteriology; Dr. C. F. Goodeve (University College) in chemistry; C. W. Darnatt (Imperial College—Royal School of Mines) in metallurgy; Dr. H. J. T. Ellingham (Imperial College of Science and Technology) in physical chemistry.

Societies and Academies

Paris

Academy of Sciences, October 11 (C.R., 205, 585-632).

PIERRE LEJAY: The absorption of solar radiation by the atmosphere in band *A*. From a discussion of the results obtained from the study of more than two hundred spectra taken over a period of two years, it is concluded that the oxygen band *A* is entirely of telluric origin. The view of W. H. J. Childs that the effective width of a line is proportional to the square root of the atmospheric mass is not supported by these observations.

LUCIEN DANIEL: Heredity in the descendants of *Helianthus Dangeardi*.

J. G. VAN DER CORPUT: A new generalization of the Goldbach-Vinogradow theorem.

JEAN DIEUDONNÉ: Continuous numerical functions defined in a product of two compact spaces.

HENRI CARTAN: The theory of filters.

ANTOINE APPERT: The effective definition of nearly isometric measurements and on the generalized limit of M. Banach.

CARLOS BIGGERI: The singularities of Laplace integrals.

ROBERT SILBER: The idea of traction and of the yield of the propelling screw and on the deviations existing between the internal and effective characteristics.

V. DOLEJŠEK and M. TAYERLE: A focusing effect for X-rays by means of a crystal with variable incurvation.

MAURICE PARODI: The characteristic frequencies of chlorates, bromates and iodates. A comparison of the Raman and infra-red spectra gives data for deciding between the plane or pyramidal structure of the group XO_3 . The latter appears to agree better with the experimental facts.

RAYMOND DELABY, LÉON PIAUX and ANDRÉ GUILLEMONAT: The application of the Raman effect to the study of some cases of allyl-propenyl isomerism.

ADREIN PERRIET: Researches on the anhydrous cyanides and cyanamides of iron, cobalt and nickel.

JEAN ALBERT GAUTIER: The hydrogenation of some nitrogen substituted α -pyridones by means of Raney nickel.

MILÉ. Y. BOISSE DE BLACK: An outcrop of Cantal basalt subsequent to a glaciation of the valley.

E. SAURIN: The presence of the fossil-bearing Norian on the coast of South Annam.

GÉRARD WATERLOT and EDOUARD ROCH: The Gothlandian of the Haut-Atlas to the east of Marrakech.

FRANZ BAERTS and ROMAIN VANDEWIJER: The alkalinity of the ash and loss of chlorine on incineration. Experiments on the loss of chlorine with corresponding formation of potassium carbonate when solutions of sugar containing potassium chloride are incinerated.

ANDRÉ GORIS: A tear-producing principle in the roots of *Ranunculus Thora*.

PAUL MATHIAS: The evolutionary cycle of a trematode of the family Alloeacrididae (*Alloeacridium auguaticolle*).

HENRY SCHWAB: Changes in the hyperglycaemic action of adrenalin by the addition of zinc salts. The hyperglycaemia caused by adrenalin is increased and its duration increased when zinc chloride is simultaneously injected with the adrenalin. Similar effects have been previously noted for insulin and it is concluded that the effects in both cases are due

to a modification of the cellular substratum, probably a change in the colloidal structure.

ANDRÉ LWOFF and HISATAKE DUSI: Pyrimidine and thiazol, factors of growth for the flagellate *Polytomella caeca*.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 469-533, Sept. 15).

R. F. KIMBALL: Inheritance of sex at endomixis in *Paramecium aurelia*. The race found by Sonneborn to have sexes I and II was used. As found by Sonneborn for conjugation, sex is segregated at the first fission after the formation of the anlagen (the portions of micro-nuclei which will form the new mega-nuclei at endomixis). Sex ratios of 1:1, 1:2 and 2:1 were found.

L. C. DUNN: A third lethal in the *T*¹ (brachy) series in the house mouse.

E. HADORN: An accelerating effect of normal "ring-glands" on puparium formation in lethal larvae of *Drosophila melanogaster*. In the mutation "lethal giant", no pupae are produced; puparium formation occurs, but at a later period than in the normal individual. Injection of "ring-gland", a small body located dorsally between the two hemispheres of the "brain", accelerates puparium formation, suggesting that this gland produces a pupation hormone.

B. P. KAUFMANN and M. DEMEREC: Frequency of induced breaks in chromosomes of *Drosophila melanogaster*. Cytological analysis of salivary gland nuclei shows that breaks occur with equal frequency in the Y-chromosomes, which are genetically inert, and in the autosomes, which are genetically active, suggesting that the structure of the chromonema is similar in all regions of the chromosomes.

F. D. MURNAGHAN: The direct product of irreducible representations of the symmetric group.

W. E. SEWELL: Degree of approximation by polynomials—problem α .

G. A. MILLER: Sets of independent generators of a finite group.

D. H. HYERS: On functional equations in linear topological spaces.

W. J. ROBBINS and F. KAVANAGH: Intermediates of vitamin B₁ and growth of Phycomyces. The thiazole and pyrimidine components of the vitamin appear to be utilized in molecularly equivalent quantities when offered as mixtures of varying proportions. This suggests that Phycomyces requires vitamin B₁ and synthesizes it from the intermediates.

P. W. WILSON and E. B. FRED: Mechanism of symbiotic nitrogen fixation. (2) The pO_2 function. Experiments in which the partial pressure of oxygen was varied lead to the view that molecular oxygen is not directly concerned in symbiotic nitrogen fixation. Indirectly it is important for its influence on the carbohydrate metabolism.

A. H. HOLWAY and W. J. CROZIER: The law for minimal discrimination of intensities (2). Experiments in which area of application on the skin is varied in extent and mechanical pressure is kept constant, support the findings with visual and auditory stimuli that least discriminable difference of intensity decreases with increase of stimulus.

W. J. CROZIER, E. WOLF and GERTRUD ZERBAHN-WOLF: Specific constants for visual excitation. The mean critical illumination for response to flicker was measured as a function of flicker frequency for a number of teleost species. The results provide support for the theoretical objection to the practice of

averaging data from individuals not necessarily genetically alike as regards the property investigated.

J. G. HAMILTON: Rates of absorption of radio-sodium in normal human subjects. Radio-sodium was prepared by bombardment of ordinary sodium chloride with deuterons from the cyclotron. The radioactive salt was dissolved in water and given orally. The radioactivity of the hand was measured by a Geiger-Müller counter held in the hand, the hand and forearm being enclosed in a thick lead box to shield the counter from radiation from the body. Absorption of radio-sodium begins within a few minutes and is apparently completed in 3-10 hours in some subjects. The method offers a new means for the study of the metabolism of sodium and other elements.

S. F. COOK, K. G. SCOTT and P. ABELSON: Deposition of radio-phosphorus in tissues of growing chicks. Radio-phosphorus prepared from red phosphorus by the cyclotron was fed to growing chicks, which were killed at different periods after administration; the radioactivity of thirteen tissues was examined. The results were in general agreement with those of Hevesy and of the Italian workers under Segrè. Radio-phosphorus was found in all tissues examined, but particularly in the skeleton and musculature. Comparison of the activities at 4 days and 60 days after administration showed marked movement of radio-phosphorus from muscle and intestine to bone, bone marrow and brain. Spleen showed high content of radio-phosphorus at all times.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 29

UNIVERSITY OF LEEDS, at 5.15.—Prof. T. H. Pear: "The Place of Imagery in Mental Processes".*

ROYAL SOCIETY OF ARTS, at 8.—Prof. J. C. Drummond: "Historical Studies of English Diet and Nutrition" (Cantor Lectures).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—L. Christensen: "Recent Reconnaissance Flights in the Antarctic".

Tuesday, November 30

ROYAL SOCIETY, at 2.30.—Anniversary Meeting.

Sir William Bragg, P.R.S.: Presidential Address.

INSTITUTION OF CHEMICAL ENGINEERS (at the Geological Society, Burlington House, Piccadilly, W.1), at 6.—Prof. A. Freundlich: "Industrial Applications of Supersonic Vibrations".

Wednesday, December 1

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers), at 7.—Joint meeting with Institution of Heating and Ventilating Engineers.

H. L. Pirie and I. Lubbock: "Fuels for Heating and Hot Water Supply".

Thursday, December 2

CHEMICAL SOCIETY, at 5.—Discussion on "The Influence of Structure on the Action of Parasiticide Drugs" to be opened by Dr. T. A. Henry.

KING'S COLLEGE, LONDON, at 5.30.—Prof. J. Chadwick, F.R.S.: "The Artificial Transmutation of Matter" (succeeding lectures on December 7 and 8).*

Friday, December 3

ROYAL INSTITUTION, at 9.—Prof. Irvine Maasson: "Iodine".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

RESEARCH CHEMIST for the Bone Research and Development Association, Ltd.—Prof. W. A. Bone, Imperial College of Science and Technology, London, S.W.7 (November 29).

SCIENTIFIC OFFICERS AND ASSISTANTS in the Explosives Directorate and the Ballistics Directorate of the Research Department, Woolwich—The Chief Superintendent (December 3).

CHEMISTS for the War Department Chemist—The Under-Secretary of State (C. 5), War Office, S.W.1 (December 6).

PHYSICIST in the Research Laboratories of the G.E.C., Ltd., Wembley—The Director.

VETERINARY RESEARCH OFFICERS in Kenya—The Director of Recruitment (Colonial Service), Colonial Office, 2 Richmond Terrace, S.W.1.

RESEARCH PHYSICIST to the Printing and Allied Trades Research Association, 10 Robin Hood Court, London, E.C.4—The Director of Research.

Official Publications Received

Great Britain and Ireland

Friends of the Hebrew University of Jerusalem. Annual Report, 1936-7. Pp. 20. (London: Friends of the Hebrew University of Jerusalem.) [311]

Report of the Council of the Royal Institute of International Affairs, 1936-1937: Eighteenth Annual General Meeting of the Institute, November 2nd, 1937. Pp. 112. (London: Royal Institute of International Affairs.) [311]

West of Scotland Agricultural College: Plant Husbandry Department. Research Bulletin No. 5: Boron in Agriculture. By Dr. R. W. G. Dennis and Dr. D. G. O'Brien. Pp. 98+14 plates. (Glasgow: West of Scotland Agricultural College.) [411]

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academic Year 1936-1937. (Published by Authority.) Pp. 144. (Cambridge: Printed at the University Press.) [511]

Chemical Changes and Chances. By Sir Martin Forster. (20th Streetfield Memorial Lecture.) Pp. 21. (London: Institute of Chemistry.) [811]

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1936. Part 1, with Report of the Geological Survey Board and Report of the Acting Director. Pp. iii+90. (London: H.M. Stationery Office.) 1s. 6d. net. [911]

London School of Hygiene and Tropical Medicine (University of London) incorporating the Ross Institute. Report on the Work of the School for the Year 1936-37. Pp. xviii+115. (London: London School of Hygiene and Tropical Medicine.) [1011]

Lily Year-Book, 1937. (No. 6.) Pp. iv+153+25 plates. (London: Royal Horticultural Society.) Paper, 5s.; cloth, 6s. [1211]

Tropical Diseases Bulletin. Vol. 34, Supplement: Medical and Sanitary Reports from British Colonies, Protectorates and Dependencies for the Year 1935. Summarized by P. Granville Edge. Pp. 247. (London: Bureau of Hygiene and Tropical Medicine.) 7s. 6d. net. [1211]

Other Countries

Annalen van de Sterrewacht te Leiden. Deel 17, Stuk 1: A Study of the Double Cluster in Perseus, based on Photographic Magnitudes and Effective Wavelengths derived from Plates taken by E. Hertzsprung at the Potsdam and Mount Wilson Observatories. By P. Th. Gosterhoff. Pp. 120+4 maps. (Leiden: Sterrewacht.) [611]

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 71: The Grazing of Sheep on Improved Pastures; its Effect on Superfine Wool. By I. Chumley Ross, N. P. H. Graham, Helen Newton Turner, H. B. Carter and H. Munn. Pp. 24+2 plates. Pamphlet No. 72: Needle Fusion of Species of Pinus in Southern New South Wales; Progress Report, 1933-36. By Dr. W. V. Ludbrook. Pp. 23+3 plates. Pamphlet No. 73: Properties of Australian Timbers. Part 2: Brown Mallet (*Eucalyptus astrigens*). By Ian Langlands. (Division of Forest Products: Technical Paper No. 23.) Pp. 20+4 plates. (Melbourne: Government Printer.) [511]

Department of Education: Baroda State. Lecture Series, 1936-37, Lecture No. 2: Some Facts relating to Educative Employment. By Capt. J. W. Petavel. Pp. 14. (Baroda: Department of Education.) 1 anna. [811]

Union of South Africa: Department of Mines: Geological Survey. The Geology of portion of the Coastal Belt near the Gamtoos Valley, Cape Province; an Explanation of Sheets Nos. 151 North and 151 South (Gamtoos River). By Dr. S. H. Haughton, Dr. H. F. Frommurtre and D. J. L. Visser. Pp. 64. (Pretoria: Government Printer.) 5s., including Maps. [1011]

U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 154 (Agricultural Series, No. 40): Analysis of Special Jobs in Quality Milk Production; Procedures and Practices for Quality Milk Production on Farms. Revised edition. Pp. v+16. (Washington, D.C.: Government Printing Office.) 5 cents. [1211]

Division of Fish and Game of California: Bureau of Marine Fisheries. Fish Bulletin No. 50: Sizes of California Sardines caught in the Different Areas of the Monterey and San Pedro Regions. By J. B. Phillips. Pp. 32. (Terminal Island, Calif.: California State Fisheries Laboratory.) [1311]

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MACMILLAN & Co., LTD.
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No. 3553

SATURDAY, DECEMBER 4, 1937

Vol. 140

Racial Doctrine and Social Evolution

IN the now not inconsiderable list of men of eminence in anthropological studies who have paid tribute to the work of Thomas Henry Huxley in the Huxley Memorial Lecture of the Royal Anthropological Institute, now approaching near to its fortieth year of delivery, no one, since the inaugural lecture in 1900 by Lord Avebury, the intimate friend of both Huxley and Darwin, has been more felicitous or more opportune in the choice and treatment of subject than was Prof. H. J. Fleure, when on November 9 he addressed the Institute on "Racial Evolution and Archaeology" (see page 981). In making the classification and distribution of races the basis of his argument, he dwelt on an aspect of the study of man with which Huxley was closely concerned, and at the same time, by associating racial studies with the results of archaeological and cultural research, he was able to draw certain inferences as to the forces making for the upward progress of mankind, which would have commended themselves to one whom Prof. Fleure and his colleagues without exception would regard as their master.

Prof. Fleure struck the keynote of his lecture when in his opening sentences, speaking of Huxley, he said : "His championship of the free conscience is more than ever needed to day, when in not a few countries the pursuit of the science of man is being seriously affected by non-scientific views." The evil, however, as Prof. Fleure went on to show at a later stage in his lecture, is even more grave than these words would suggest. It is not merely that racial theory is being constrained to lay false emphasis on the part played by the racial factor and by certain races in the advancement of civilization, as well as on the character and standing of those races, but also racial doctrine is made the

instrument of attack on that freedom of conscience, of which it was Huxley's conviction that the process of growth is in a very deep sense the essence of progress in the development of civilization. The call of the blood—in other words, the claims of the group—are made to transcend and override personal right to the exercise of individual judgment.

The conflict between authority and the right to individual judgment, in which Huxley and other great figures of the latter half of the nineteenth century were so long and strenuously engaged, had seemed to be won—fully in the field of science, where truth alone, without regard to prepossessions resting on extraneous consideration, was accepted universally as the acid test of validity. It is unnecessary to recall the course of events by which, since the Great War, science in certain countries has been harnessed to political ideals of varied complexion ; but the perversion of ethnological science to support the authority and supremacy of the group over freedom of thought and judgment has been tragic in its consequences, both socially and in the field of science.

In his survey, vast in space and time, of the evolution of races and of their migrations over the surface of the globe, and of the part played by these races, each in their turn, in the development of civilization, Prof. Fleure was in a position to demonstrate that the history of mankind is a story of the development of individuality and its emancipation from the chains of the social group, which, indeed, he suggested may perhaps be traced back as a relic of even pre-human days. In every phase of cultural growth, from the stage of the food-gatherer to the higher forms of

civilization, there is evidence of "an increasing purpose". So far from society being, as the political philosophers would have it, a system of restraints imposed upon the original freedom of man in his natural state, the history of human progress, as Prof. Fleure interprets the evidence, is the story of the emancipation of the individual conscience from the suppressive influence of group pressure, which favours mediocrity alone.

Nor does the theory of the superiority of the racially homogeneous group as a progressive force receive any support from racial history. As anthropologists generally hold, and as Prof. Fleure agrees, it is probable that no society, at least of any size, is composed of a racially homogeneous group, nor has been so composed since at least the days of the food-gatherers. Further, as Prof. Fleure went on to point out, in a society composed of racially heterogeneous groups, such as have been formed in the course of the kaleidoscopic movement of racial migration which has been taking place for thousands of years, there is evidence to show that adjustments and compromise have taken place between the different groups, each of which has had its own racial history behind it, and, possibly, each with its own characteristic mental attitude and outlook.

From the conflict, however, which thus arises, when the ritual of one part is set over against the ritual of another, discussion takes place, and as Prof. Fleure puts it, leads to the valuing of justice rather than ritual. This must have happened even with such a military caste as the Nordics, whom a perverted racial theory has elevated to a pinnacle which is less than deserved. For even in the larger groupings which seem to have come about through the domination of tillers by herders, especially when the latter have been of a militarizing tendency, the group developed with a diversity of tradition and with diverse ranks of a hierarchical society, and nearly everywhere the result has been that the immigrant rulers have had to accommodate themselves to the prejudices and customs of the subject masses.

It would appear, in fact, that the dogma of the political philosopher that the development of society is from status to contract, when interpreted in the light of the evidence of ethnology and archæology, must be taken to mean that in the development of civilized society the line of progress has been, not a class conflict, but in the direction of an ultimate adjustment of rights and

privileges among those varied sections of society, which may in fact be rooted in diverse racial origins and are certainly linked with differences of tradition and social outlook. Such an adjustment to be lasting cannot be imposed by superior authority but must be the result of free and unfettered discussion.

"What does not Britain owe", asks Prof. Fleure, "to the fact that Celtic, Teutonic and Romance cultural contributions to the common life have intertwined without complete dominance by any one of them?" He points out that, in the instance of Holland, which welcomed the persecuted, we marvel at the richness of development of individuality in a society orderly above the average of its time and not particularly distinguished as a whole.

On a view of the history of human development such as has been put forward by Prof. Fleure, there cannot be two opinions but that the verdict lies in favour of the racially heterogeneous rather than the homogeneous group. But what of the future? Will the unity of purpose and action of a society, which exacts uniformity in composition, culture and social ideal, prevail over the weaknesses inherent in its denial of what history has shown to be the evolutionary trend? On such a question we cannot do more here than refer to the conclusion at which Prof. Fleure has arrived. If the group working towards 'autarky' by the suppression of thought and intellectual intercourse loses its perspective, throwing out its best workers, thinkers and artists in the interest of mediocrity, strongly tinged with jealousy, it loses the means of keeping in contact with the ceaseless process of change. Further, by the suppression of the principle of freedom of conscience, it becomes an anti-scientific authoritarianism, because it denies that "which is the life-breath of science."

Such, then, is the verdict of detachment—the view of the anthropologist, who from his survey of the trends of development in civilization throughout the great expanses of space and time of man's history, is brought to the conclusion that in freedom alone, freedom of development and freedom of expression, does truth, material, moral and spiritual, emerge. To this may be added as a legitimate corollary that the aim of society must be to ensure not its own formal permanence, which is the triumph of the machine, but the maintenance of such conditions as will best keep open a way for man to the attainment of his ultimate destiny, whatever that may be.

Physics of Music

(1) Science and Music

By Sir James Jeans. Pp. x + 258 + 10 plates. (Cambridge: At the University Press, 1937.) 8s. 6d. net.

(2) Music and Sound

By L. S. Lloyd. Pp. xiv + 181. (London: Oxford University Press, 1937.) 10s. 6d. net.

THE increase in the appreciation of music in Great Britain, and the importance of a knowledge of acoustics for such purposes as the control of noise and the design of public halls, make the appearance of two books on this subject extremely opportune. There is, however, a fundamental difference between them. Sir James Jeans approaches the reader who has no technical knowledge and interests him in music and its associated physics alike; but Mr. Lloyd addresses the musician, and leads him on to scientific principles for the sake of the understanding that he will thereby gain.

(1) It is true that "Science and Music" is eminently readable and contains no mathematical symbols; but that seems to impose no limitations on the author: his discussion of the physical principles is clear and satisfying. He is equally at home when discussing the countless details on which music depends, or the recent investigations into the measurement of reverberation. On the purely musical side the book is full of good matter, and could only have been written by an expert familiar with orchestral instruments.

The book begins with a fascinating account of the development of the ear, and then describes the fundamental facts about frequency, beats, resonance, the vibrations of a stretched string and harmonics. There follows an account of the factors which govern the tones of the piano and other stringed instruments. We have an analysis of the physical conditions which produce the Stradivarius quality of a violin; the author even hints that X-ray analysis may in time lead to its mass production.

After a study of the vibrations of air, we have a description of edge-tones and the way in which the eddies produced control the sound of a flute organ-pipe; reed pipes follow and then applications to the chief wind instruments of the orchestra. Interesting light is thrown on many of their problems, including their characteristic timbre and the way in which pitch can be varied by the player's lips. Perhaps in a future edition it may be explained how the sound of a clarinet, owing

doubtless to the reed, contains a second harmonic of 3.5 times the amplitude of the fifth (p. 150) and yet the instrument will overblow to the fifth harmonic and not to the second.

Another chapter is devoted to discord and the origin of the musical scale, with an account of the various attempts to overcome the difficulties of equal temperament; it is only when the reader finishes the chapter that he realizes that he has been taken through a series of subjects that in less able hands would have been very severely technical. (There is an obvious slip in the top line of p. 143, for the wolf-fifth contains about 7.4 semitones.)

The last two chapters handle the transmission of sound from its source to the ear-drum and its transmission from the ear-drum to the brain. In spite of a still current impression to the contrary, the problem of constructing a public hall with good acoustic properties has been solved, and we have a clear account of the effect of various materials upon absorption: incidentally, the marked musical superiority of wood over felt or canvas of equal absorbing power in the middle register is explained as due to less damping of the higher notes and of the harmonics; music will therefore sound brilliant and rich in a wooden room, but dull and dead when the damping is produced by felt and canvas.

When we come to the discussion of the processes in operation between the ear-drum and the brain, with their many subsidiary questions, we have the author at his best: among many interesting facts we learn how in many of our radio sets all frequencies below middle *C* are cut out; yet we hear the double-bass strings and male voices with absolute clearness.

The value and attractiveness of the book are increased by an exceptionally good series of photographs and diagrams. It will fascinate those interested in music and will be very useful to physical students for its account of the modern work upon sound.

(2) In the introduction to "Music and Sound", it is rightly pointed out that, while a knowledge of acoustics is useful to the musician, the scale has been developed by composers, and the indications from physics can only be accepted when they agree with what counterpoint teaches: a composer should learn to think in terms of the pure scale and must therefore study music of the polyphonic period, when music was written for unaccompanied voices.

The book begins with a satisfying investigation of major and minor scales and the effect of modulation in displacing the notes. Then come discussions of temperaments, mean-tone and equal; and of chromatic notes, decorating notes and intonation, a number of the results, such as the difference between $F\sharp$ and $G\flat$, being worked out in commas.

In Chapter iv, combination tones and beats are handled in an interesting way, from the point of view of the concert-room rather than the laboratory. But at first sight one point is rather puzzling. The author on p. 40 accepts Helmholtz's view and holds that combination tones are produced in the ear, yet he says on the previous page that experiment confirms a general observation denying it. The author next deals with consonance, dissonance and the effects of mistuning, and his specialist knowledge leads to some striking remarks. Thus on p. 64:

"the major chord of the 6/4 is acoustically the smoothest consonance, yet for centuries the art of music has treated this chord as a discord. There is a significant sentence in Helmholtz's work: 'The dispute as to the consonance or dissonance of the fourth has been continued to the present day'. This dispute is, in effect, whether

music is an art or a science. No room for controversy would have been left had the test of the disputants been that of the use of the 6/4 by Bach in his forty-eight preludes and fugues for the clavier."

The handling of musical notes, audibility and resonators is on ordinary lines and is followed by an excellent chapter on the organ pipe and orchestral instruments. In spite of the limitations imposed by the holes and valves of the wind instruments of an orchestra, it is satisfactory to have it on Stanford's authority that in the orchestra the compromise of 'equal temperament' has no place.

The author lays stress on the drawing of graphs in order to obtain a concrete grasp of acoustic principles, and in the last chapter gives a good example of their value in discussing the vibration of strings. Having excluded from the text all but the most elementary mathematics, he provides for further information a number of short appendixes, the last being an excellent note on auditoriums.

The book is obviously written by a trained musician; its style is clear and its mode of presentation fresh. It is strongly to be recommended to those for whom it is written.

G. T. W.

Recent Work in Enzyme Chemistry

Enzyme Chemistry

By Dr. Henry Tauber. Pp. xii + 243. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 15s. net.

CONSIDERING the complexity of the problems presented by enzyme chemistry and the remarkable achievements which have been made of late in this branch of biochemistry, there is little doubt that the appearance of a book describing accurately and concisely recent advances would be very welcome. Dr. Tauber has attempted this somewhat formidable task. His book, as the author states in his preface, "makes no claim to completeness", whilst theoretical considerations are intentionally reduced to a minimum. Presumably the book is to be read as an addendum to more complete works on enzyme chemistry.

After a short introductory chapter dealing very briefly with such topics as enzyme specificity, activators and inhibitors, reversible inactivation, the carrier theory, and the mechanism of enzyme synthesis, the author turns to the descriptive work which forms the main feature of his book. He deals first with esterases and then, more at length,

with the proteolytic enzymes. Here there is to be found a good description of the work of Northrop and his colleagues on the crystallization of members of the proteinase group (pepsin, trypsin, chymotrypsin, etc.), and a not too adequate description of the recent work of Bergmann and his associates. The author, for example, states (p. 87) that "it is not known whether papain is a single enzyme or a mixture of two or more enzymes", whereas Bergmann and Ross (*J. Biol. Chem.*, 111, 659; 1935) make it clear that there must be in natural papain two different proteolytic enzymes, a proteinase and a polypeptidase, the former of which is reversibly inactivated by oxidation and the second irreversibly inactivated (see also Bergmann and Ross, *J. Biol. Chem.*, 114, 717; 1936). The author then turns to the amidases, lightly touching upon such enzymes as asparaginase, aspartase and tyraminase, and giving more attention to the preparation and some of the properties of urease and arginase. Carbohydrases are next dealt with, and finally oxidizing enzymes and systems are described. Catalase, carbonic anhydrase and luciferase are distinguished by each having a separate chapter.

Dr. Tauber cites (p. 162) as the first experimental proof of the formation of an intermediary enzyme-substrate compound the reaction between catalase and monoethylhydrogen peroxide described by Stern. Keilin and Hartree, however, claim (*Proc. Roy. Soc., B*, 121, 173; 1936) that ethylhydroperoxide is not a substrate of catalase, no decomposition (to acetaldehyde) taking place with a weak solution of the enzyme free from other hæmatin compounds and from alcohol.

Dr. Tauber describes the dehydrogenase systems scappily and inadequately. Keilin is credited with the conclusion (p. 169) that "the succinic enzyme is a complete enzyme system consisting of a dehydrogenase, cytochrome, and the oxygen-activating indophenol (or cytochrome) oxidase". The finding of Banga, Laki and Szent-Györgyi that the oxidation of β -hydroxybutyric acid to acetoacetic acid is due to the same enzyme-co-enzyme system which oxidizes lactic acid (p. 172) is quoted without the additional statement that these authors (*Z. physiol. Chem.*, 220, 278; 1933) afterwards retracted this conclusion. It is now known that the two systems are distinct. There

is little mention of the properties of the amino-acid dehydrogenases.

Confusing and inaccurate statements and misspellings appear—evidence, doubtless, of hasty proof-reading. For example, we find the following sentence, "Tyrosine, monophenols and aromatic diamines are not attacked" by laccase (p. 186), whereas, of course, such monophenols as guaiacol and *p*-cresol, as the author has actually previously mentioned, are attacked by laccase.

There is a number of omissions of subjects which certainly should have found some mention in this book; for example, glyoxalase and the co-enzyme properties of glutathione, action of eserine on choline esterase, protective power of substrates and allied compounds on enzyme inactivation by dyestuffs, etc., equilibria established by xanthine oxidase, etc., recent concepts of constitutive and adaptive enzymes. Quite apart from these and other omissions, however, it is evident that Dr. Tauber's book requires some revision, and it is to be hoped that he will be able to accomplish this in the not too distant future.

J. H. Q.

Human Embryology

A Textbook of Embryology

By Prof. H. E. Jordan and Prof. J. E. Kindred. Third edition. Pp. xiv + 613. (New York and London: D. Appleton-Century Co., Inc., 1937.) 25s. net.

THIS text-book by two Virginian embryologists has served a useful purpose in the past and will continue to do so in the future. It deals more particularly with human development, and the comparative method in deducing and interpreting the progressive changes is used but sparingly, the authors preferring generally to fill in lacunæ in our knowledge by postulating hypothetical stages rather than by referring to data derived from the study of other animals. In special cases, however, and more especially in describing the development of the foetal membranes and their appendages, the comparative method is freely adopted. Furthermore, in the interpretation of vestigial and transitory structures full use is made of the 'law of recapitulation'. The separate section on "Laboratory Exercises" continues to be a feature of the work. The present edition does not differ materially from the last, but there are some additions, more particularly to the chapters on hæmopoiesis and sex determination, and certain errors in other parts of the book have been corrected.

Of the errors which have been allowed to remain,

those relating to ovulation, the corpus luteum and the sexual cycle are perhaps the most noticeable. Thus, the corpus hæmorrhagicum is described as the mass of clotted blood which fills the cavity of the ruptured ovarian follicle and constitutes the first stage in the formation of the corpus luteum. The name 'corpus hæmorrhagicum' or 'blood follicle' is now reserved for degenerate undischarged follicles which have never ruptured, and in the figure such a one is shown in the *centre* of the ovary and duly labelled. The lutein cells can scarcely be said to "invade the corpus hæmorrhagicum" since they are actually formed from the undischarged follicular epithelium, and the cells which grow inward from the wall are connective tissue elements, these giving rise to a network surrounding the enlarged lutein cells.

Again, in dealing with the time of ovulation, the authors cite Siegel's statistical data pointing to the occurrence of the process about the tenth day after the beginning of the menstrual flow. They omit to mention the work of Shaw, Knaus, Ogino and others and the more recent work of Hartman showing definitely that in a normal menstrual cycle ovulation usually takes place about the fourteenth day. Moreover, the oestrous cycle is incorrectly described. The diæstrus is not simply a quiescent period, but is now known to be of the

nature of an abbreviated pseudo-pregnancy. The authors confuse the dioestrus with the prolonged period of rest known as the anæstrus and are wrong in stating that in monoestrous animals the dioestrus includes almost the whole year, for such species do not experience a dioestrous period. Monoestrous animals are not those which experience "only one annual heat period", for the dog is definitely monoestrous (that is, it has only one œstrus in a sexual season); yet the dog, as is well known, comes on heat and breeds, as a general rule, twice a year. Moreover, it can no longer be affirmed that the proœstrus of the lower mammal corresponds simply to the menstrual flow of the human female.

There is a paragraph describing Spemann's work up to 1924 on the process of differentiation

of the ovum, but we would have liked some account of the more recent advances in experimental embryology. In view of the great complexity which the study of the sex hormones has attained as a consequence of recent researches, it may be doubted if the Lillie-Minoura explanation of the 'free-martin' can be held in the simple form in which it was presented.

A word of praise must be added for the excellent illustrations, and the book as a whole may be recommended to medical students and practitioners who desire a clearly written presentation of the principal facts of human embryology. Such criticisms and suggestions as are made above have been put forward with a view to further improvement when the book reaches a fourth edition.

F. H. A. MARSHALL.

Aspects of Higher Mathematics

(1) *Leçons sur la théorie des espaces à connexion projective*

Par Prof. E. Cartan. Rédigées par Dr. P. Vincenini. (Cahiers scientifiques, Fascicule 17.) Pp. vi + 308. (Paris: Gauthier-Villars, 1937.) 85 francs.

(2) *Differential Systems*

By Prof. Joseph Miller Thomas. (American Mathematical Society, Colloquium Publications, Vol. 21.) Pp. ix + 118. (New York: American Mathematical Society, 1937.) 2 dollars

(3) *Introduction mathématique aux théories quantiques*

Par Prof. Gaston Julia. (Cahiers scientifiques. Fascicule 16.) Première partie. Pp. vi + 220. (Paris: Gauthier-Villars, 1936.) 60 francs.

(4) *Éléments de géométrie infinitésimale*

Par Prof. Gaston Julia. (Cours de la Faculté des Sciences.) Deuxième édition. Pp. vii + 262. (Paris: Gauthier-Villars, 1936.) 60 francs.

(5) *Über einige neuere Fortschritte der additiven Zahlentheorie.*

Von Edmund Landau. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 35.) Pp. vii + 94. (Cambridge: At the University Press, 1937.) 6s. net.

(1) **P**ROF. CARTAN'S work on the theory of spaces with projective connexions is executed in accordance with a plan originally set forth in another work of his on generalized spaces. The present volume is divided into two parts, the first of which serves as an introduction to the second, and presents a survey of the different

methods employed in projective differential geometry with emphasis upon those which may be generalized in the theory of spaces with projective connexions proper. Prof. Cartan chooses the simplest of problems here; indeed certain of them are chosen only for their instrumentality in illustrating the different methods employed. Thus, as he says, the first part cannot lay claim to being in any sense an exhaustive treatise on projective differential geometry.

In the second half of the book Prof. Cartan passes on to consider spaces with projective connexions proper, and, as in Riemannian geometry, once the general theory is introduced, two kinds of problem arise. First, there are the problems which are consequent upon the consideration of the properties of these projective spaces themselves and their differentiation from the classical projective space; and secondly, there are those which arise from the consideration of the properties of the curves and surfaces in such spaces. Prof. Cartan does not, in this work, go into the latest developments in generalized projective geometry, but he includes an extensive bibliography of works expounding the most modern researches.

(2) In his extremely interesting treatise on differential systems, Prof. Miller Thomas is primarily concerned in developing the theory of partial differential equations and that of Pfaffian systems in such a way as to show clearly the relations between the two theories. He uses the postulational method as being the most conducive to generality and conciseness, and proceeds to take a few existence theorems and construct his theory upon them. He includes a consistency

proof by proving the postulates in particular cases. There is no systematic development of the theory of commutative polynomial rings in this book, but Prof. Thomas develops in detail the theory of the non-commutative ring known as the Grassmann ring from the postulates of Chapter iii, and in Chapters iii and iv he develops the ideas introduced by Grassmann and perfected by Cartan.

The treatment of the algebraic case is entirely the author's own, and an individual feature of the work which he considers most satisfactorily exhibited in the algebraic case, but which is employed throughout, is the admission of inequations on an equal footing with equations. Together with the use of resultants of all orders, he finds that this admission obviates the necessity of making the preliminary linear transformations of the indeterminates in the solution of algebraic systems.

(3) Of Prof. Julia's two volumes, that on the elements of infinitesimal geometry is a fairly straightforward treatise the substance of which originated in a course of lectures on the geometrical applications of analysis. Prof. Julia finds that the method of vectors provides greater simplicity in the establishment of generality in results. But, in particular problems he thinks that the utilization of Cartesian co-ordinates or some other canonical system of reference which is appropriate to the geometrical nature of the problem under examination, effects a simplification in analysis. A combined use of the geometrical and analytical methods is what distinguishes Prof. Julia's treatise from others of its kind. This second edition contains many additions and a few modifications of detail, all introduced in order to give greater precision and exactitude to the exposition.

(4) Prof. Julia's other work is the first 'fascicule' of a series which is to constitute a mathematical introduction to quantitative theories. In this introductory part of the work Prof. Julia investigates the properties of vector spaces of n dimensions and their linear transformations. Geometrically, a theory of linear operators is obtained which is translated analytically by a theory of matrices. The choice of co-ordinates appropriate for obtaining the simplest matrix of a given operator leads naturally to the reduction of matrices and to the study of the spectrum; in affine geometry the reductions of Jordan are obtained, and in metric geometry the reductions of Schur. This work is once more the result of the combination of analytical and geometrical methods.

(5) In 1935 Prof. Landau delivered the Rouse Ball Lecture in the University of Cambridge under the title "Solved and Unsolved Problems in the Additive Theory of Numbers". The progress which has been made since that date in the solution of some of the problems described by him, forms the subject of this little volume. The substance of three further lectures on "The Class-Number of Binary Quadratic Fields", in which Prof. Landau produced a full proof of Siegel's very important theorem on the class number of the quadratic forms of negative discriminants, is also included here. For the understanding of this summary of progress made, a knowledge of the elements of the classical theory of numbers excluding the theory of prime numbers, is sufficient. Prof. Landau is so well known an authority in this branch of mathematical theory that it is superfluous to say that any utterance of his is of great importance.

A. v. Z.

East Africa

Mountains of the Moon:

an Expedition to the Equatorial Mountains of Africa. By Patrick M. Syngé. Pp. xxiv + 221 + 93 plates. (London: Lindsay Drummond, Ltd., 1937.) 15s. net.

"THE 1934-1935 British Museum Expedition to East Africa was organized for the purpose of studying the flora and fauna of the equatorial mountains in relation to their peculiar environment." This, the opening paragraph in Mr. Syngé's book, succinctly describes the subject about which it is written, one not perhaps new, but fully deserving the attention it receives at the author's hands.

Ruwenzori, with its gigantic lobelias and senecios

and the other abnormalities distinctive of its extraordinary flora, was the main objective, but Mts. Elgon and Kenya, the Aberdares and several of the Birunga volcanoes were also visited, and although these are better known than Ruwenzori, the author contrives to present the botanical wonders that he saw and the events of the journeys to find them with a pleasing freshness.

The latter part of the book is devoted to a carefully recorded impression of Uganda—past, present and future—from the political and social points of view. This was Mr. Syngé's first visit, but his remarks are well worth careful reading. He deals comprehensively with the subject. Greatly interested in the rise of European education in Africa, he concludes that the mental capacity of

the boys he saw at work, Baganda at Budo and Makerere, is equal to that of the average of European peoples, or the difference is extremely slight. Certainly he feels hopeful of the results; hints at possibilities of improvement, is sceptical of the wisdom of studying Coleridge, of questions on electric lifts and trams, thinks that the English language will eventually oust Swahili as the *lingua franca* of the country, speculates whether the art of Epstein would not appeal more to the native mind than that of Raphael, and is convinced that "Territory can only justifiably pass from one mandatory power to another by a plebiscite of its population."

Appendixes deal first with the legends relating to the sources of the Nile and the Mountains of the Moon, and secondly, with the possibility of the acclimatization in Britain of some of the African mountain plants the author saw.

The illustrations are varied and striking: partly taken from oil paintings and drawings by Stuart Somerville, two in colour; and partly from photographs taken by various members of the expedition. They are by no means the least noteworthy part of the work. Two maps and an index are provided. One slip may be mentioned: the duiker is an antelope, not a deer.

J. P.

Oyster and other Fisheries of Great Britain

(1) Oyster Biology and Oyster Culture:

being the Buckland Lectures for 1935. By Prof. J. H. Orton. Pp. 211. (London: Edward Arnold and Co., 1937.) 5s. net.

(2) The Nation's Sea-Fish Supply:

being the Buckland Lectures for 1936. By E. Ford. Pp. 112 + 4 plates. (London: Edward Arnold and Co., 1937.) 3s. 6d. net.

(1) **T**HE earlier course of Buckland Lectures is devoted to the oyster, a full investigation of which was subsidized for some years, commencing in 1919, by the Empire Marketing Board acting through the Ministry of Agriculture and Fisheries. There was at that time an immense mortality amongst the oysters of the east coast of England, and it was suggested, rather hysterically, that this was due to the dumping of trinitrotoluene in that region—an obvious impossibility. The real cause has never been explained, but the researches of Prof. J. H. Orton and the information obtained by him and here presented will save a second such waste of public money.

Of this presentation we can scarcely write too highly both as to its form and substance—the complete life-history of the 'Native' and an excellent account of its culture. This oyster is shown to be protogynous, changing its sex to the male immediately after spawning and again evicting its gametes. Then, many of the oysters in winter become female and afterwards again revert to male—four changes of sex in thirteen months. Spawning takes place on the beds when the temperature of the water rises to about 60° F., but the causes of good and bad spawning years is still unknown.

(2) In the second course of lectures, Mr. Ford examines our fish supply, stimulated thereto by the profound change effected in the industry by

the Sea-Fishing Act of 1933, followed up by the formation of a Herring Industry Board of Control in 1935, probably the prototype of a Whitefish Board in 1938. Previous to this, British vessels were subject to little or no regulation either as to catching or marketing, but few will be prepared to contest the necessity for this somewhat socialistic measure.

To understand the matter it is essential to appreciate the change that has come over Great Britain in recent years, the greatly increased provision of meats, fruit and vegetables at standard prices and so put up that they can be served without further preparation, each purchase 100 per cent nutritive. At present, at least half the fresh fish sold is from the counters of the fish friers, fish otherwise being largely a luxury product, as can be seen from the fact that it has little or no interest to co-operative societies. In consequence, the industry, while formerly thinking largely in terms of fish-bulk, now has to deal mainly with the demand for species in economic quantities. Before the Great War there was a question of overfishing of grounds induced partially by thoughts of lessened catches, these met later by geographical boundaries being extended and improved methods of fishing.

Still the question of a holocaust of undersized fish is with us, but the researches of the western nations of Europe in the International Council for the Exploration of the Sea, reconstituted in 1919, now make possible the free acceptance of international regulations, such as sizes of mesh of nets and size limits for each marketable fish. The author is an acknowledged expert whose discussion is always both of value and of importance—and above all he bids us to remember that "fish are livestock which need to be exploited with reasonable care and caution".

Gmelins Handbuch der anorganischen Chemie
Achte völlig neu bearbeitete Auflage. Herausgegeben
von der Deutschen Chemischen Gesellschaft.

(1) System-Nummer 36: Gallium. Pp. xviii+iv+100. 13.87 gold marks.

(2) System-Nummer 37: Indium. Pp. xviii+iv+118. 15.75 gold marks.

(3) System-Nummer 23: Ammonium. Lief. 2: Verbindungen bis Ammonium und Kalium, Hydrazonium, Hydroxylammonium. Pp. 243-602. 44.25 gold marks.

(4) System-Nummer 59: Eisen. Teil A, Lief. 8: Fe-C (Fortsetzung); mechanische und thermische Eigenschaften; Systeme Fe-C-H bis Fe-Be-K. Pp. 1635-1818. 24.37 gold marks.

(5) System-Nummer 59: Eisen. Teil D: Magnetische und elektrische Eigenschaften der legierten Werkstoffe. Pp. xlviii+466. 57.75 gold marks.

(Berlin: Verlag Chemie, G.m.b.H., 1936.)

(1 AND 2) The metal gallium was rather neglected until about 1915, when advantage was taken of the long interval between its low melting point and high boiling point to use it either alone or alloyed with five per cent of indium for filling high-temperature thermometers. Gallium has also been used effectively by Bates for alloying with cadmium in the construction of an enclosed cadmium arc lamp. The alloy has a much lower melting point than pure cadmium and does not adhere to the silica on cooling, so that the risk of fracture is greatly diminished. Moreover, the arc spectrum of the cadmium is scarcely affected by the presence of gallium. Indium has as yet found very little commercial application. It was formerly obtained exclusively from zinc-blende, but is now a by-product in the cadmium residues of the lithopone industry. Recently, Brewer and Miss Baker have discovered unusually large amounts of it in cylindrite, a lead-tin-antimony sulphide from Bolivia, and also as a general impurity in tin.

(3) The volume on ammonium contains an account of the salts of the radicals ammonium, hydrazonium and hydroxylammonium. Of the numerous ammonium polysulphides mentioned in the literature, only one, the pentasulphide, is definitely known. The two amino-groups in hydrazine are unequally basic since only one series of salts is stable, except in the case of the halogen hydracids. The stability of the hydroxylammonium salts towards acids, alkalis and oxidizing and reducing agents is set forth.

(4 and 5) Section 8 of Part A of the volume on iron deals with the mechanical and thermal properties of the metal and with heterogeneous equilibria between iron and the elements oxygen, nitrogen, sulphur, silicon, phosphorus, arsenic, antimony and the alkali metals. Part D gives a complete account of the magnetic and electrical properties of iron alloyed with numerous elements, other than carbon, these having been separately dealt with previously. The usefulness of this part is greatly enhanced by the inclusion of more than three hundred phase rule diagrams.

Elektronentheorie der Metalle

Von Dr. Herbert Fröhlich. (Struktur und Eigenschaften der Materie: eine Monographiensammlung, herausgegeben von F. Hund und H. Mark, Band 18.) Pp. vii+386. (Berlin: Julius Springer, 1936.) 28.80 gold marks.

THE electron theory of metals is now so far developed that it can provide adequate explanations of a very large number of the experimental facts concerning the electrical, magnetic and thermal properties of normal metals, and can help us considerably in our understanding of the behaviour of abnormal ones. It is therefore essential for a physicist to have at hand an authoritative and up-to-date survey of the subject. Dr. Fröhlich provides such a survey, starting with a discussion of the fundamental principles of wave mechanics and leading on to a discussion of problems in the emission of electrons, photo-electricity, optical and magnetic properties, the latter being set forth with pleasing clarity. Then follows a sound treatment of electrical conduction and allied phenomena, succeeded by articles on semi-conductors and on the metallic state in general. The last two chapters, which give an account of ferromagnetism and a systematic examination of the properties of individual metals, are well worth reading.

Fundamentals of Vacuum Tubes

By Prof. Austin V. Eastman. Pp. xv+438. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 24s.

THERE seems no limit to the number of large textbooks recently devoted to the operation of practical thermionic devices. The present one aims at combining theory and practice for senior engineering students, not attempting to appeal to the specialist. It assumes a working knowledge of the simple calculus, but emphasizes practical ends in developing the fundamental theoretical aspects. Although thermionic tubes find most varied use in radio transmission circuits, these are not allowed to swamp the increasing importance of industrial applications. Gas tubes and photo-electric devices are naturally included in the general discussion. Both the method of comprehensive treatment and clarity of expression are to be commended.

L. E. C. H.

Biology and the New Physics:

a Plea for a Consistent Philosophy of Life. By C. J. Bond. Pp. 67. (London: H. K. Lewis and Co., Ltd., 1936.) Paper covers, 1s. 6d. net; cloth, 2s. 6d. net.

THE rapid changes in the theory and practice of science call more and more for a synthetic adjustment of the complete universe of knowledge. However difficult this task is, one should welcome any genuine attempts towards its completion, as each one of them may open new perspectives which may serve a wider and more comprehensive synthesis. Mr. Bond's forceful and brief plea for a consistent philosophy of life is most interesting from this point of view, and should be read with profit by all those who place values in the forefront of their speculations.

T. G.

The Grain-like Structure of Solids*

By Sir William Bragg, O.M., K.B.E., P.R.S.

A CURSORY glance over the research work described in the scientific publications of to-day shows that remarkable interest is concentrated on magnitudes which are too small to be examined in detail under the microscope and too large to be studied conveniently by X-ray methods. Such magnitudes are to be found in all lines of research, medical, industrial, and purely scientific. Their behaviour presents numerous problems of great interest, and also of considerable difficulty. Solutions are of pressing importance, because the want of knowledge is in all cases a hindrance to progress. When in the course of our work we arrive at these magnitudes we realize that we are facing a key position.

The microscope makes it possible to detect objects as small as a few hundred angströms in diameter, but it is far from revealing the details of objects so small as this. There are other optical methods of detecting such magnitudes. Thus Langmuir has recently shown how the polarization effects of films no more than a few dozen angströms thick can be made visible: but again this method does not supply a means of examining detail.

The X-rays in a sense go too far. Their wavelengths are such that the crystalline arrangement of atoms and molecules can be measured with very great accuracy, but their field of view is too narrow to take in the details of larger structures. Thus there is a gap in the means of inquiry, and it is remarkable how consistently the particular deficiency has inconvenient results.

Magnitudes of this order occur, for example, in the metallurgical field. Their importance is more obvious now that the structures of metals and their alloys are better known. The X-ray methods determine with accuracy the details of the crystal structure of iron and its alloys, but such information is insufficient for a prediction of the behaviour of a specimen of steel. As Smekal has observed, there are certain properties which are clearly connected with structure; and are 'insensitive' to any treatments to which the steel has been submitted in its previous history. But there are other properties, to be described as 'sensitive', which can be modified profoundly by treatment, such as tensile strength, plasticity and hardness, as well as electrical and magnetic properties, and these are most important qualities in practice.

Long ago the microscope showed the metal to be an assemblage of grains; and the conditions of the assemblage are clearly connected with the 'sensitive' properties. But the exact details of the connexion are difficult to investigate because they fall within the region in which direct illumination fails.

Metallurgical theory hovers continually over the idea that a metal or an alloy contains minute groups of atoms, or is even a compound of such groups, which may be called crystallites, since the arrangement of the atoms within each one is perfectly regular. The X-ray diffraction is regular, and the lines of a 'powder diagram' are clear and sharp. Thus Gough and Wood in their examination of the fatigue of metals due to the cyclic repetition—sometimes to millions of times—of an imposed stress, found that the visible grains gradually broke up to an extent which in any one experiment depended on the magnitude of the stress. Fracture in any one region occurred when the break up into crystallites was complete. It did not imply the disruption of atom from atom, resulting in complete disarray, but merely a separation into minute crystals the magnitudes of which were arranged more or less closely about some average. This was shown by the form of the X-ray photograph. A definite stage had been reached in the break up of the material. The existence of such an average would imply that the dimensions of the crystallite are in some way referable to numerical relations between the form or dimensions of the atoms of the metal: analogous to, but far more complicated than, the formation of the benzene ring of definite form and size from atoms of carbon each of which has tetrahedral qualities.

The discussion as to the specific existence, nature and effect of crystallites has been conducted with great eagerness; very much research on the mosaic structure of crystals in general has been undertaken, and several interesting theories have been put forward. At first, theories were suggested which would have provided a super lattice, consisting of a regular arrangement of crystallites, even in the case of a pure metal. But this suggestion could not be maintained, as it evolved a second linear dimension out of a first. Buerger has suggested that the grain-like structure of a metal is due to conditions of growth, various crystalline processes meeting and joining together in irregular

* From the presidential address to the Royal Society, delivered on November 30.

fashion during the formation of the whole mass. This, however, would lead to a casual formation which does not seem to be in accord with metallurgical experiment. G. I. Taylor's ingenious theory of the hardening of a metal by working requires the existence of crystallites of some form. The whole question is still obscure, yet it is extremely important because the properties of metals and alloys depend to a large extent on the grain-like structure which they possess. Whether so-called 'crystallites' are formed under some law governing their size or are merely accidental assemblages, they are a centre of interest in the examination of metallic properties.

Similar conditions prevail in other cases where the behaviour of materials is under consideration. In April of this year the International Association for the Testing of Materials met in London. The work of the conference was closely connected with pure scientific research, depending on results already obtained and suggesting numerous opportunities for the increase of knowledge. It was remarkable that in the case of one material after another the discussion directed attention to the importance of grain-like structure, and showed that the 'grain', if I may extend the word widely from its general use in metallurgy, was the object of attack. Thus in the vast variety of fibrous materials, the fibre corresponds to the metal grain, and its study is quite as interesting and important. In all colloidal problems the condition and properties of the minute particle are fundamental. In materials derived from living organisms, the cell and its parts are the centre of interest; and of course somewhere in the region of which I am speaking are the outposts of life itself. Even in dielectrics and lubricants, the groupings of atoms and molecules determine the general behaviour.

Moreover, a very considerable change in the use of materials for construction has come about in recent years in consequence of the fact that the gradual changes due to time have become really important. The so-called 'creep' of materials is now one of the chief pre-occupations of the engineer. Its new importance is due to two causes. In the first place, the development of machinery has necessitated more perfect fitting, and less allowance for clearance than was at one time the case, as for example in modern turbines and internal combustion engines. In such fine adjustments a creep of one part in a thousand is a very serious matter. In the second place, the working temperatures have been greatly increased, and creep is thereby encouraged. There is no doubt that in any specimen but a perfect crystal slow changes take place continuously. At every moment molecules are being helped over the barriers which have

kept them from positions of greater equilibrium. In this way new crystallizations are set up, or older crystallizations extended. Strain may encourage transfer from one position to another. One might almost say that every portion of a solid is a liquid for a certain fraction of its time, and that the atoms in that portion are capable of a movement which is restricted and guided by the stabilizing action of their surroundings.

The laws which govern these movements are very complicated, and detailed knowledge is scanty though badly wanted. Thus, for example, Dr. Bailey, a pioneer in these matters, finds that the addition of 1 per cent chromium to a 0.5 per cent molybdenum steel increases its initial resistance to creep below a certain temperature and lessens it above. It is probable that the addition of chromium atoms locks the grain structure so long as they stay where they are: but heat facilitates their moving, all the more readily because the complicated alloy has the looser structure. Once they have moved, the material would be better without them. But such a rough explanation would be well set aside for a detailed knowledge of the processes involved. Here are very interesting problems of physics and chemistry.

The careful examination of a visible cellulose fibre shows, it is said by some, that it is built up of lesser fibres, fibrillæ or fibrils which again consist of ellipsoidal objects of dimensions roughly 1.5μ and 1.1μ . Each such object may contain many millions of cellulose chains, but very little is known of the structure of the contents or of the sheath that encloses them and seems to be the source of their characteristic influence. Chemical analysis and X-ray examination give a satisfactory picture of the cellulose chain-like molecule, and some information also of the details of the molecular assemblages. But information is wanted respecting the larger groups and the fibril formation on which the fibre properties obviously depend. If the fibre belongs to a living organism, change with time may be synonymous with growth. If the fibre is an element of some material in use, it is still subject to change which may seriously affect its quality.

Change may be external or internal. The slow rearrangements of recrystallization or devitrification are due to internal forces: but surface changes due to reactions with surrounding atoms such as corrosion or hydration may also affect behaviour. Naturally such surface changes are the more important the smaller the particle of the substance, as the colloid chemist points out. Thus, for example, it is a much discussed question as to how clay holds the water that is associated with it. The X-ray analysis supplies a very reasonable picture of the clay crystal; the positions of the

atoms of oxygen, silicon, aluminium, magnesium, iron and the rest are known with considerable accuracy. But the remarkable properties of clay are dependent on the behaviour of the larger flake-like assemblages of colloidal dimensions, which lie between the direct observation of the X-ray methods and those of the microscope.

In dielectrics the slow changes of time bring about rearrangements, hastened by the electrical tensions to which the material is subjected. The electrical forces look for the weakest point for a break-through, just as a stress discovers the weakest point of a chain or any member of a structure. Changes are therefore important. One would wish that a structure was like the "Deacon's shay", which was so designed that every part was as strong as every other so that when the shay came to its end, it became a heap of dust upon the road. Unfortunately, that is not the case with any material in use: and whatever its structure an equal balancing is apt to be destroyed by changes in its grain-like condition.

Perhaps the structure of the huge protein molecules may suggest a way of closing the gap in our knowledge and our means of inquiry. It is a very striking fact that their magnitudes tend definitely to group themselves about certain values, which, moreover, are simply related to one another. They are not mere groups of atoms thrown together without design. Their definite formation implies obedience to rules which must be in force at the beginning of the assembling, and are in force until an unavoidable result is reached. This would mean, as indeed a vast number of observations already imply, that the junction of carbon atoms is

governed by strict geometrical laws of distance and orientation. It has indeed been pointed out by Dr. Wrinch and others that the long chains consisting of two carbons and one nitrogen in regular succession can be formed, under the guidance of the rules mentioned, into space-enclosing sheets presenting an external appearance of linked hexagons, and the number of sizes to which these assemblages can attain is limited. Possibly we have here an example of a form of procedure from the groupings of a few atoms to the larger assemblages of thousands, the process depending on a certain obedience to laws of building which have been shown to hold in the simpler case. We are encouraged to hope that this may be so, by the unexpected strictness and definiteness of the building rules in the cases which fall within the scope of the X-ray methods.

The constitution of the solid body is being examined now as it has never been possible to examine it before. We are not surprised that it is found to possess a grain-like structure, or that this structure is of first-rate importance. It is not only of interest from the purely scientific point of view, but also it turns out to be of fundamental importance to all the constructive work of industry and to all the examinations of living constructions within the domain of biology. In the effort to know its details and to understand their significance a host of interesting scientific inquiries make their appearance, so that industry and science more than ever play into each other's hands. It is certainly to be expected that from these tempting labours there will result much improvement of natural knowledge.

Progress in the Transport and Storage of Foodstuffs

THE work of the Food Investigation Board is carried out in the interests of the general body of consumers in Great Britain and is directed to reducing waste and improving the variety and quality of foodstuffs generally available by the application of scientific knowledge to the problems of storage and transport. The annual report of the Board*, besides describing the Board's activities, includes, in the report of the Director of Food Investigation, a concise statement of the progress of the investigations carried out during the year under review, many of which have not yet reached the stage at which full publication of the results

is feasible. The keynote of the Board's activities in 1936 was its co-operation with other bodies interested in similar problems of food preservation in different parts of the world. The British Commonwealth Scientific Conference met during September 1936, and the members visited the various experimental stations maintained by the Board, namely, the Low Temperature Research Station at Cambridge, the Torry Research Station at Aberdeen, and the Ditton Laboratory at East Malling in Kent. The seventh International Congress of Refrigeration was held at The Hague in June 1936 and was attended by several members of the Department of Scientific and Industrial Research. A number of visits abroad were paid by members of the Food Investigation staff: thus

* Report of the Food Investigation Board for the Year 1936: Department of Scientific and Industrial Research. Pp. 235 + v. (London: H.M. Stationery Office, 1937.) 3s. 6d. net.

Dr. A. J. M. Smith proceeded to South Africa to consult with the authorities there on a number of questions relating to the export of foodstuffs; Dr. R. G. Tomkins went to Palestine to discuss questions relating to the transport and storage of citrus fruits; Dr. E. C. Smith was present at the opening of the new laboratories of the Kälte-technische Institut at Karlsruhe, and finally Dr. F. Kidd, superintendent of the Low Temperature Research Station, proceeded to South Africa to act as chairman of a commission set up by the Government there to inquire into matters connected with the export of deciduous fruits.

A 'refresher' course was held at Cambridge, in co-operation with the National Institute for Research in Dairying, the Fruit Preservation Research Station, Chipping Campden, and the Torry Research Station, and was attended by members of the Services, of research associations and of the scientific and technical staffs of various firms. Members of the Engineering Committee attended meetings of a consultative group, consisting of representatives of the manufacture of refrigerating plant, and of the consultative group which represents the shipping industry, thus having brought to their direct notice the actual problems encountered in commercial practice.

The Board has arranged for the preparation of a report dealing with the application of thermodynamical methods to the equilibrium state in biological systems, including industrial applications of the biological sciences, and also of a report summarizing our present knowledge of the chemistry of the apple.

The Board makes a special reference to its relationship with home agriculture, pointing out that the distinction between production, on one hand, and transport and storage, on the other, is justified on the grounds of expediency alone. It is obvious that where the agricultural product is to be stored or to receive other special treatment, production and research in production must have that end in view. Producers require a specification towards which to work; the preparation of that specification is the task of the Board. Although research has not gone far enough to make such specifications possible yet to any great extent, still it is already possible in some measure to specify, in scientific terms, what is required of the producer in an apple for storage, in a fish for smoking, and in a pig for the manufacture of bacon. Such specifications will increase in scope and accuracy as research progresses.

It is possible to refer here only to a few of the results obtained in the many scientific researches carried out by the members of the Food Investigation staff. Some of those with a probable immediate practical application will be selected. From the

results of investigations at the Ditton Laboratory during the past few years, it appears that the pear responds even more favourably than the apple to gas-storage; Conference and William's Bon Chrétien varieties can be stored successfully for several months at 34° F. in atmospheres containing 2.5-10 per cent oxygen and 5-10 per cent carbon dioxide. It appears that the successful achievement of long periods of storage depends to a great extent upon bringing the fruit to gas-storage at a low temperature with the minimum of delay after gathering. After removal from the store the fruit ripens more slowly and therefore allows more time for marketing than fruit that has not been stored in this way. It is hoped that this new knowledge will lead to a considerable increase in home production.

The condition known as 'storeburn' is due to excessive evaporation of water and can be prevented if the foodstuff is suitably wrapped. Aluminium foil covered with waxed paper has been shown to be a suitable wrapping for both frozen lambs' kidneys and Sussex poultry, when stored at -10° C. The birds were trussed and allowed to cool and set (with the heads down) for 16-20 hours at room temperature before storage; after five months the fowls were thawed and drawn. The guts, including the liver, were found to be firm and perfectly wholesome; the birds were cooked and eaten and found to be indistinguishable from freshly killed chickens.

Last year it was reported that muscular tissue from the carcasses of pigs that had been overheated before slaughter had an abnormally high electrical resistance; it has since been found that hams made from these carcasses showed an unusually high incidence of taint. Farm-killed pigs give low values for electrical resistance and a low incidence of taint. The electrical resistance of factory-killed pigs can be reduced to a certain extent by resting the animals before slaughter. The high electrical resistance is associated with a rise in the ultimate pH of the tissue after death—presumably due to loss of glycogen during the exercise taken just before death—and a decrease in the rate of penetration of salt during curing, two factors which predispose to bacterial spoilage.

Other interesting results have been obtained on the retention of fertility in eggs during storage, on the storage of potatoes and broccoli and on the corrosion of the tinplate container used for canned foodstuffs, but for the details of these the original report must be consulted. The extracts already given must suffice to indicate the activities of the Food Investigation staff during the past year.

The Sex-Ratio

AT the recent Nottingham meeting of the British Association, the first morning was devoted by Section D (Zoology) to a symposium on the sex-ratio. This was introduced by Prof. F. A. E. Crew's presidential address, which reviewed the subject in detail and formed an essential part of the discussion as a whole. A number of the facts brought forward by the speakers, and the conclusions drawn from them, merit the attention both of general biologists and of those interested in the various aspects of the population problem.

In man, the secondary sex-ratio, being that which obtains at birth, approaches equality, with a small but definite excess of males. At the present time in England it is approximately 105.6 : 100. There is no doubt that this is derived from a much higher sex-ratio at conception (the primary sex-ratio) by a differential elimination which favours the female. A continuance after birth of this lower male viability reduces the sexes to equality in late adolescence. Afterwards it reverses the ratio, leading to an excess of females which steadily increases in the higher age groups until there are more than twice as many women as men amongst those aged eighty-five years and more.

The effect of this constitutional difference in vigour is expressed in varying degree. Unsuitable conditions, both before and after birth, tend to enhance it, and a favourable environment will partially, but not completely, obscure it. Furthermore, Dr. W. O. Kermack pointed out that it is subject to secular trends which are reflected in the sex-ratio when studied over long periods.

Two fundamental difficulties are encountered in explaining these facts: the lower viability of the male sex, and its excess at conception. The latter condition is especially remarkable, for the simple chromosome mechanism by which the sexes are controlled seems adapted to ensure their initial equality. Prof. Crew rightly stressed that these two problems can only be interpreted by a comparative study of a wide range of organisms.

The differential viability of the sexes is the more easily approachable subject. Now it may seem that the sex-determining mechanism is itself sufficient to account for this phenomenon, as one of the sexes (the heterogametic sex) possesses but a single X-chromosome. Its partner is the Y-chromosome. This retains a homologous pairing, as well as a non-homologous differential segment; a feature discussed by Dr. P. C. Koller, who showed that it secures the separation of the sex-

determining regions. However, the genes carried in the non-homologous part of X, which is often large, are without corresponding factors, or allelomorphs, in Y. Thus their action, even when recessive, and therefore disadvantageous, cannot be obscured by normal allelomorphs. These, however, prevent the expression of such recessives in the other, or homogametic, sex; for this lacks the Y, being provided with two X-chromosomes. Even here they will occasionally operate, but only when present in double dose, and this is a rare event. There is thus a tendency towards lower viability in the heterogametic sex, which is the male in the human species and other mammals. However, it was shown during the present discussion that this attractive theory is in fact inadequate to explain the departure of the sex-ratio in favour of the female.

This is a conclusion of considerable importance. It was reached by a consideration of the sex-ratio in those forms in which the chromosome mechanism of sex-determination is reversed, the female being the heterogametic sex. If the theory just outlined were an adequate explanation of the facts it seeks to explain, the bias of viability should here favour the male. Two groups of this kind are available for study: the birds and the Lepidoptera. The data on their sex-ratio, supplied respectively by Prof. Crew and Mr. E. B. Ford, indicated that, contrary to expectation, the male still remains the less hardy in these forms.

We must therefore regard the lower viability of this sex rather as an outcome of maleness itself than as a result of a particular chromosome constitution. It has been demonstrated that the metabolic rate of the male, whether heterogametic or homogametic, is higher than in the female, and it appears to be in this greater expenditure that the explanation of his lower viability is to be found. The chromosome mechanism must indeed play a part, in the way outlined, but it seems to be a subsidiary one. It was also suggested that agents such as calcium salts may play a part in determining the sex-ratio, through a differential elimination of the sexes. Further information appears to be necessary before this view can be sustained.

Prof. Crew directed attention to the circumstance that, at least in man, the period when the falling sex-ratio brings about transient equality is that of early sexual maturity. It appears, then, that the various factors controlling the sex-ratio are adjusted by selection to procure an equal number of males and females at the time when, in a primitive

society, reproduction is affected. Dr. J. R. Baker and Mr. A. J. Marshall maintained that the sex-ratio is non-adaptive, a conclusion reached by their studies in the New Hebrides, for their figures indicated an excess of males in most of the species examined there. The sex-ratio of the nestling birds, however, approached equality, and we may perhaps question if the subsequent disparity is not to be accounted for, at least in part, by sexual differences in habit among the adults.

Prof. Crew pointed out that the high sex-ratio

at conception may be explained by the selection of genes tending to produce an excess of Y-bearing sperms, and that such are, in fact, known to exist. Clearly selection would favour a primary sex-ratio high enough to counterbalance, as far as requisite, the lower viability of the male. As explained by Dr. A. Walton, the ease with which the sperms can be subjected to experimental treatment, together with the different physiology of the X- and Y-bearing types, give ground for hope that means may be found for separating them. The artificial control of sex would thus become possible.

Obituary Notices

The Right Hon. Sir Herbert Maxwell, Bt.,
K.T., F.R.S.

SIR HERBERT EUSTACE MAXWELL, Bt., of Monreith, died at his home in Wigtownshire on October 30 at the age of ninety-two years. Notwithstanding his great age, and the predecease of nearly all his contemporaries, he retained to the end a mind and spirit refreshingly youthful. His energy, too, was surprising, and, irrespective of weather, he continued to pay his regular fortnightly visits to Edinburgh, leaving his home at an early hour of the morning, to attend a business meeting.

Neither at Eton nor at Oxford did Maxwell distinguish himself; in fact at neither public school nor university did he complete the normal course, yet notwithstanding his lack of application in his earlier years, a lapse which afterwards he bitterly regretted, such was his natural ability and concentration that he lived to be one of the most brilliant Scotsmen of his age and generation.

On leaving Oxford, Maxwell studied for a time at South Kensington with the intention of taking up painting as a profession, but this aim he relinquished when he married and settled down in the country. To the end of his days, however, he continued to use his talent for painting, and has left behind him a large collection of flower studies, executed with remarkable fidelity, charm and skill. Specimens of his work were exhibited at the Royal Horticultural shows in London and elsewhere in recent years.

In 1880 Sir Herbert was returned to Parliament for his native county of Wigtown, and thereafter he continued as its representative until 1906. He accepted the office of Junior Lord of the Treasury in Lord Salisbury's administration of 1886, and at the same time he was appointed assistant Scottish Whip, a post which he continued to occupy for the nine succeeding years. Though eager for promotion to Cabinet rank, fortune did not favour him, and this he attributed to the fact that his duties as a Junior Lord of the Treasury deprived him of the opportunities of taking any part in debate. Though he was offered various appointments to Colonial

governorships when in the House, he declined them. Not only was he one of the most popular men, but also he had the reputation of being the best dressed man in the House of Commons.

It was not until he was a man of forty that Sir Herbert turned his attention to writing, but from that date onwards anything he wrote readily found a publisher, and his output was exceptional. Works on history, biography, philology, natural history came from his pen, and he will long be remembered by the brilliant series of essays, "Memories of the Months", dealing with every aspect of country life throughout the year. The personality of the author is vividly revealed in the pages of these essays. His keen powers of observation, his sensibility, his knowledge of natural history, his ideals of sportsmanship, his scholarship and his love of the country and the country folk fill the pages. So popular are these essays, and so perennial their interest, that quite recently a fresh issue was made, nearly twenty years after their first publication.

His distinction as a horticulturist was recognized by the Royal Horticultural Society when in 1917 it conferred on him the honour of V.M.H. Besides being the author of "Scottish Gardens", "Trees" and "Flowers", he was a frequent contributor to horticultural periodicals. A singular honour was his election as a fellow of the Royal Society under Statute 12, "in the interests of advancement of natural knowledge".

Archæology appealed to Sir Herbert's mind—the desire to penetrate into the history of his native land behind the written record. The draining of the Looh of Dowalton on the Monreith estate when he was still a comparatively young man and the exposure there of a group of lake dwellings afforded him an opportunity. These and other crannogs were excavated with a party of friends, and were the first structures of their kind to be explored systematically in Britain. A notable collection of relics was recovered which Sir Herbert Maxwell presented to the National Museum of Antiquities of Scotland. At a later date, a valuable collection of relics brought

together by himself was also presented to the same Museum.

As a fellow of the Society of Antiquaries of Scotland, Sir Herbert always took an interest in its proceedings, and in 1901 he was elected president of the Society, a post he occupied until 1913. He was on two occasions, in 1893 and 1911, Rhind lecturer in archaeology. When in 1885 an Archaeological Society was founded to publish accounts of the archaeological and antiquarian remains in the counties of Ayrshire and Wigtown, Sir Herbert was one of the vice-presidents, and for a number of years took up the duties of an honorary secretary. His contributions included an article on the heraldry of Galloway, illustrated with coloured plates prepared by himself.

With these tastes, it was but natural that Sir Herbert should be offered the chairmanship of the Royal Commission on Ancient and Historical Monuments (Scotland) when it was appointed in 1908, an offer which he gladly accepted. For twenty-seven years he presided over the Commission until to the great regret of his colleagues, on the plea 'that it was better to anticipate the failure of his faculties than to outlive it', he resigned. In his parliamentary days he had presided over other Royal Commissions, including that on tuberculosis in 1897. When the Scottish National Library was finally established, Sir Herbert Maxwell, though then eighty years of age, was chosen by the Trustees to be their first chairman. He was appointed lord lieutenant of his county in 1903, and in 1933 he was created a knight of the Order of the Thistle, an honour rarely bestowed on a commoner, and one which gave delight to himself and to a large circle of his fellow countrymen.

It may truly be said that few men by their passing leave such a pleasant memory behind to such a large number of friends as has Sir Herbert Maxwell. He was laid to rest at the little kirk of Kirkmaiden beside the sea, where many of his forebears for three hundred years had preceded him. The procession that followed him to his grave is said to have extended for two miles along the country road, notwithstanding the remoteness of the spot, an indication of the esteem in which he was held.

A. O. C.

Dr. Adolf Lehmann

ADOLF LEHMANN was born in 1863 at Orillia, Ontario, of German parentage. He died in Kingston, Ontario, on September 27, after eight years of invalidism, brought on by a paralytic seizure. His unflinching courage and optimism did not leave him during those long years of inactivity and helplessness.

Dr. Lehmann studied agricultural chemistry at the Ontario Agricultural College, and organic chemistry under Wislicenus at Leipzig, where he worked on the reduction of dibenzene diphenylbutadiene to tetraphenylbenzene. He acted as assistant chemist at the Dominion Experimental Farm at Ottawa, and as chemist at the Agricultural Experimental Station

in New Orleans. In 1898 he went to India to establish a State department of agriculture for the Government of Mysore. His training at Ottawa and New Orleans fitted him for his work at Mysore. His nine annual reports to the Government of the State are filled with data on the growth of such crops as sugar-cane, rice, coffee and sweet potatoes under different conditions of rainfall, amounts of fertilizers, time of planting and harvesting. Analyses of soils, fertilizers, feeds and foods were carried out in great numbers. During this time he developed a method for the estimation of phosphorus in plant and animal material.

On returning to Canada, after a short period as a teacher of organic chemistry at Queen's University, Dr. Lehmann was called to the new University of Alberta to organize the Department of Chemistry. Here he spent his most fruitful years, not only as professor of chemistry, but also, in the earlier years, as provincial analyst and professor of soils. In the new province he stimulated an interest in scientific agriculture by his work in the laboratory and in his contacts with all classes and conditions of people. He made the earliest systematic examinations of the bitumen in the bituminous sand deposits of the Athabaska River, which have intrigued men of science and entrepreneurs for many years. He saw his department grow from a mere handful of students to more than 700 in the eighteen years of his work in Alberta.

Dr. Lehmann was an active and valued member of many scientific societies. Even after soil chemistry came into other hands in the development of the University of Alberta, he maintained his interest in agricultural science and agricultural organizations. But his great service was done in the classroom and with his students and colleagues, whom he inspired by his scrupulous exactness and his devotion to his work. The present writer, who knew him as a colleague, is indebted to a fellow worker with Dr. Lehmann, Dr. O. J. Walker, for much of the above details. In Dr. Walker's words: "His many graduates speak for the interest he gave them in science, for they are scattered over the North American continent, engaged in teaching and in industry. They were always able to feel that their mentor was interested in their activities, and shared in their successes and failures."

We regret to announce the following deaths:

Dr. G. A. Boulenger, F.R.S., formerly in charge of the Reptile Collections in the Department of Zoology, British Museum (Natural History), on November 23, aged seventy-nine years.

Prof. Edward L. Nichols, emeritus professor of physics in Cornell University, on November 10, aged eighty-three years.

Mr. C. G. Rogers, C.I.E., formerly chief conservator of forests, Burma, on November 18.

Sir Seymour Tritton, K.B.E., past president of the Institute of Locomotive Engineers, also known for his work in connexion with the British Standards Institution, on November 19, aged seventy-five years.

News and Views

Pilgrim Trust Lecture

TIME and again in these columns it has been urged that the international character of science gives its disciples a special mission at the present time in promoting co-operation among the nations. Indirectly, by correspondence with other workers and by international congresses, something has been accomplished; individuals of different nationalities have been brought together and have learned to appreciate something of each other's points of view and mode of approach to a problem. There is, however, plenty of scope for further movement on these lines, and we therefore welcome the announcement in the annual report of the Council of the Royal Society that the Pilgrim Trust has agreed to provide 250 guineas a year for six years for an annual lecture, to be arranged jointly by the Royal Society and the U.S. National Academy of Sciences and to be given alternately in London and Washington (p. 979). The fact that a body of the character of the Pilgrim Trust has supported the proposal, and that it was put forward jointly by the two leading scientific bodies of Great Britain and the United States, is of great significance. The foundation of the lecture, coming almost simultaneously with the announcement that negotiations of an economic character are to take place between the two countries, should make even stronger the link binding together the English-speaking peoples of the world in peaceful progress. The first lecture will be given next summer, in London, by an American man of science.

SIR WILLIAM BRAGG made special reference to the Pilgrim Trust Lecture in his presidential address. As he rightly pointed out, these lectures, from the circumstances of their origin, might well be used to mark the progress of science rather than to honour particular scientific workers. They should not be summaries of past work, however important that may be, for other provision already exists for its recognition; rather they should serve to transmit new ideas which have already begun to bear fruit and give promise of wide expansion in the future. By means of the lectures, it will be possible to convey the personal character in the work of a man who opens up a new field of advance, which can only be done adequately by the man himself. Sir William also expressed the hope that the universal wish to promote peaceful relations between the nations of the world may induce other bodies to establish similar lectures. The regular exchange of men able to transmit to other nations the new knowledge which is being gained should indeed be firmly established and recognized by learned academies and by States as a substantial means of promoting progress in all

fields of knowledge, as well as the conditions of peace necessary to secure it.

A Lost Neanderthal Tooth

AMONG the recent accessions to the British Museum (Natural History), South Kensington, some of which are referred to later in these columns, is a molar tooth of Neanderthal man. This tooth has been identified as a 'milk tooth', which originally formed part of a series of palaeontological specimens collected in Gibraltar by Capt. F. Brome, governor of the military prison, and forwarded by him to England in 1865. The tooth was mentioned by Mr. George Busk in 1868, after which date it disappeared and had been lost to science for nearly seventy years. Its recognition is due to Dr. A. Tindell Hopwood of the British Museum, who furnishes the following particulars of the identification. An unworn human tooth, fastened to a small square of blue paper and contained in a cardboard pill-box without lid, was received some months ago in the Department of Geology with various specimens from the Royal Dental Hospital. This, with some others, was passed to Dr. Hopwood for examination. His interest was aroused by a small printed label gummed to the paper and identical with labels on specimens from Gibraltar already in the Museum. This suggested that the tooth might be the one reputed to have been found by Brome, and examination disclosed the correct date (24.2.65) written in ink in the lower left-hand corner and on the back of the blue paper "I'm under six years"—evidently the ground for constant reference to a milk tooth, and leaving little doubt as to the origin of the specimen. Capt. Brome's investigations in the Genista cave, from which the specimens came, lasted over a period of years in the 'sixties of the last century. The cave, which was named "Genista" in his honour, was discovered when the prison, of which he was governor, was being enlarged, and in the course of digging a new tank, fissures were observed in the limestone.

Gibraltar Man

THE gift of this historic tooth of Neanderthal type from Gibraltar to the British Museum (Natural History) serves to recall the fact that it is only by little more than an accident that a certain primitive type of *Homo* is now known specifically as "Neanderthal" and not as *Calpious*, from Calpé, an ancient name for Gibraltar; for the first known example of Neanderthal man came to light in a rock-shelter, or the remains of a cave, in Forbes' Quarry, Gibraltar, in 1848, nine years before the discovery of the type skull in the valley of the Neander in Germany. The history of the discovery was found by Col. E. R.

Kenyon in 1910 in the minutes of the long defunct Gibraltar Scientific Society. The skull was presented to the Society by the finder, Lieut. Flint, its secretary; but its remarkable and peculiar character was not appreciated until long after, when in 1862 it was sent to England by Capt. F. Brome, governor of the military prison, with a quantity of palaeontological material which he had obtained from the Genista cave, where he carried on investigations for some years. It was then examined by Mr. George Busk and Dr. G. H. Falconer, who immediately recognized its importance as a new and distinct type of *Homo*, the latter wishing to give it, as already mentioned, specific rank in classification. The skull has since been the subject of study by almost every anthropologist of note from Huxley to Keith; and although it differs from the type in certain respects, and its age is not precisely determinable, all are agreed that it is a pleistocene skull belonging to the Neanderthal group. While some would regard the differences from the type as due to its sex (female) others hold that they are marks of an early and primitive character, such as have since been found in the Neanderthaloid skulls from Palestine. A similar skull, but of a child of five years of age, was found in 1926 by Miss D. Garrod in a recently discovered cave; and in the same stratum were flint implements of late Mousterian type. The original Gibraltar skull was presented by Mr. G. Busk to the museum of the Royal College of Surgeons of England, where it is now exhibited.

Prof. P. M. S. Blackett, F.R.S.

PROF. P. M. S. BLACKETT, of Birkbeck College, University of London, who succeeds Prof. W. L. Bragg in the Langworthy chair of physics at Manchester, is engaged mainly in work on cosmic rays, and it is fair to say that nearly all the cosmic ray research in Great Britain has been done with his advice or under his direction. Blackett's first important scientific work was the development of the Wilson cloud chamber into an automatic instrument for the study of rare events such as close nuclear collisions and nuclear disintegrations. He investigated the energy and momentum relations in these processes in the Cavendish Laboratory between 1922 and 1932. Following the discovery, by Skobelzyn, of tracks ascribed to cosmic ray particles, Blackett devised the counter-controlled cloud chamber in which the expansion is initiated by the passage of the cosmic particle and the track is formed and photographed before the ions are diffused. The counter controlled chamber placed in a magnetic field allows the measurement of the energy of the particles, and Prof. Blackett has been occupied with this method of investigating the cosmic rays since 1933, using latterly the large magnet erected for the purpose for the Royal Society. He had established a school of cosmic ray research at Birkbeck College, and several of his collaborators will continue their work at Manchester. In addition to this main interest, Prof. Blackett has worked on the production and properties of positive electrons and on the specific heats of gases.

Improvements in Television Equipment

It is natural to expect that the continuous operation of a public television broadcasting service in Great Britain will be accompanied by steady improvement in technique and equipment. An outstanding advance in the latter has recently been achieved by the production of the Super-Emitron camera in the laboratories of the Marconi-E.M.I. Television Co., Ltd. This new camera has already reached the stage of practical application, since it was used recently by the B.B.C. in television broadcasts of the Lord Mayor's Show, and of the Cenotaph ceremony on November 11. A brief technical description of the new camera, published in the *Wireless World* of November 18, shows that the major improvement depends upon the separation of the photo-electric screen and the mosaic screen which is scanned by the cathode ray beam. As a result of this separation, the photo-electric surface, upon which the visual image of the scene being transmitted is focused, may be made transparent. In this way, certain limitations placed upon the optical projection system of the present Emitron cameras have been removed; lenses of shorter focal length and wider angle may be used, and even telephoto lenses when required. Further, the separate mosaic screen may be made from substances having high secondary emission, and consequently considerable electron multiplication may be obtained in the tube itself, thus giving additional overall sensitivity. With the new camera, therefore, less illumination of the subject is necessary for the attainment of a good picture if the normal aperture lens system is retained. This is a valuable feature in outdoor broadcasts on dull days, or when using a telephoto lens for the reproduction of distant scenes. If the normal illumination is retained, however, as in studio work, the aperture of the lens can be reduced with a consequent gain in depth of focus.

ALTHOUGH in the United States of America regular television broadcasts have not yet commenced, a considerable amount of research is in progress in the development of television technique and equipment. An additional stage towards the inauguration of a commercial service has been achieved recently by the installation of a high-frequency coaxial cable between New York and Philadelphia, a distance of ninety miles, by the American Telephone and Telegraph Coy. A note from Science Service dated November 10 describes a demonstration in which 240-line television images were transmitted over this cable, which is designed for operation at 1,000 kilocycles per second. Starting in New York, the signals pass through amplifiers about every ten miles. The power for these amplifiers is transmitted through the cable along with the signals, thus making the system independent of any local power source. Special equipment has been designed to prevent the distortion that would otherwise result from the varying velocity of the different signal frequencies along the cable. In the demonstration described, the image reproduced on the cathode ray tube receiver was about eight inches square, and news reels and animated scenes were transmitted over the cable with no important loss of detail.

Marconi and Radio Communication

At a meeting of the Royal Society of Arts on November 10, Sir Ambrose Fleming presented a paper entitled "Guglielmo Marconi and the Development of Radio Communication". The object of the meeting was to commemorate the achievements of the Marchese Marconi, whose work on the practical use of electro-magnetic waves has laid the foundations of a great industry, and provided a means of inter-communication of great importance and advantage to the human race. Sir Ambrose took the opportunity of tracing the early history of electric wave telegraphy, starting with the theoretical work of Clerk Maxwell published in 1865. The experimental demonstration of the existence of electromagnetic waves was provided by H. R. Hertz some twenty years later, and rapid progress was afterwards made by the investigations of Sir Oliver Lodge, Admiral Sir Henry Jackson and other workers.

CONTEMPORANEOUSLY, Marconi was experimenting in Italy and, at about twenty years of age, he came to Great Britain and applied for his first British patent in June 1896. Marconi had a special flair for the practical application of the principles established by others and for overcoming the many and various difficulties encountered in this application. Under his guidance and inspiration, wireless communication advanced rapidly with a continuously widening scope. Sir Ambrose Fleming was personally associated with much of this pioneer work, and he has drawn on this experience with advantage, in presenting an accurate and interesting outline of the progress of radio communication during the past forty years. When the paper is published in the *Journal of the Royal Society of Arts*, it will form a useful historical document, which should prove of great value to the large and rapidly extending class of young radio engineers who are only dimly acquainted with the course of events in the early years of this art.

Science and the Unobservable

At his Friday evening discourse before the Royal Institution on November 26, Prof. H. Dingle discussed "Science and the Unobservable". An outstanding characteristic of modern physics is the application of the principle that only that which is observable is significant. The first example of such application to arouse general discussion was the abandonment by Einstein of the idea of the absolute simultaneity of events at different places, because of the discovery that it was impossible to determine absolutely whether such events were simultaneous or not. This step met with the criticism that since absolute simultaneity in itself was independent of the means available for observing it, it was illegitimate to call the idea meaningless merely because of the limitations of physicists. On the other hand, the followers of Einstein maintained that if the physical world were regarded as including entities or conceptions which were unobservable either directly or indirectly, there was no criterion for distinguishing the real from the unreal.

AN analysis of the process of observation shows that unobservables fall into three classes: (1) the *logically* unobservable, namely, that which cannot be said to be observed without breaking the laws of reason, for example, a round square; (2) the *physically* unobservable, namely, that which cannot be observed because no physical means exists by which the observation could be made, for example, absolute motion; (3) the *practically* unobservable, namely, that which cannot be observed because of lack of technical skill, for example, the far side of the moon. The last two classes, however, cannot be distinguished in practice unless we assume that we know completely all the physically possible means of observation which exist. The practice of physics is to reject the logically and the physically unobservable and to accept the practically unobservable. Hence, since physics distinguishes between the physically and the practically unobservable, it must assume that we know completely all the physical means of observation which exist. From the realist point of view, therefore, we are in the dilemma that we must either assume omniscience in this sense, or else confess that we have no guarantee that what we observe has any importance when compared with the equally real physically unobservable part of the universe. The dilemma disappears if we adopt the idealist doctrine that the physical world is a mental construct formed to give rational meaning to our observations. In that case we reject the physically unobservable because our aim is to construct the world out of observation and not out of fancy, and we do not presume omniscience because we erect no barrier against further observations of any conceivable kind. It follows that modern physics is justifiable only in terms of an idealistic philosophy.

Water Supply and Public Works

A SERIES of papers at the recent Public Works Congress dealt with water supply. The connexion between water supplies and town planning was discussed by Mr. G. H. Thiselton-Dyer, who pointed out that, with few exceptions, sources of water supply are suspect or actually polluted, and that it is doubtful whether even those which are regarded as safe will remain so under the changing conditions of modern life and the scrutiny of the bacteriologist, who can now detect evidence of contamination which was not revealed by older methods of analysis. It was also remarked that it appears to be inexpedient to use the Town and Country Planning Act of 1932 to reserve areas in town planning schemes with the view of preventing pollution, unless the schemes provide for the payment of adequate compensation to the affected landowners. The possibilities of the Lower Greensand as a source of water supply for Greater London was discussed by Mr. H. Dewey, who concludes that no great reliance can be placed upon this source for such a purpose, although use might be made of it as a source of auxiliary supply. The geological section across the London Basin which was included in the paper would have been enhanced in value had the lower limit of the Lower Greensand been shown on it.

RECENT water shortages in various parts of Great Britain lend significance to the paper by Mr. E. G. Bilham on weather and water supplies, in which it is suggested that although the primary source of our water supplies is rainfall, loss of rainfall by evaporation and by seepage is of major importance, and that it is only possible to study this loss by comparing accurate values of rainfall with similar values of run off. So far, this has only been attempted in the case of the Vyrnwy catchment area. Studies of factors affecting the corrosion of water mains and services are given in a paper by Dr. W. H. J. Vernon and Dr. F. Wormwell, the first portion of which deals with methods of protection of the interior of the pipes, a suggested possibility being treatment of the water conveyed with a view to the elimination of corrosion, and a second method being the application of protective coatings. External corrosion by soil and other causes is also dealt with, together with methods of protection in this instance also.

Fifth Annual Exhibition of Kinematography

THE fifth Annual Exhibition of Kinematography arranged by the Royal Photographic Society was held in the Society's house at 35 Russell Square on November 13-27. The Exhibition included examples of the latest types of kinematographic apparatus, a series of interesting exhibits arranged by technical firms within the industry, together with a comprehensive display of still pictures from recent productions. It was opened by Colonel J. T. C. Moore-Brabazon. In his address, Colonel Moore-Brabazon stressed the importance of kinematography in education, research and in the preservation of records, and paid tribute to the progress which has been made, particularly on the mechanical side and in the general design of apparatus. An interesting series of lectures and demonstrations was arranged to run throughout the course of the Exhibition, on technical subjects connected with kinematography, standard and sub-standard.

It is true to say that this Exhibition succeeded in demonstrating how close is the relationship between the Royal Photographic Society and the kinematograph industry, and how many and great would be the advantages to both of a closer association. In the past a limit has been placed upon the activities of the Royal Photographic Society by the size of the premises at 35 Russell Square. New premises have, however, recently been acquired in which, after reconstruction, there will be three lecture halls, a library, museum, a council room, meeting rooms and a members' lounge, and under these conditions the way will be made easy for further developments. The expense entailed in connexion with the acquisition and reconstruction of the new premises is, of course, very great, and an appeal for funds has lately been launched by the Society. It is hoped that the response will be adequate; science and industry have profited greatly by the advances made in photography, and the premier photographic society in the world deserves well of the community.

The Newcomen Society

AT the annual general meeting of the Newcomen Society, held at the Institution of Civil Engineers on November 17, Engineer Captain E. C. Smith was elected president for 1937-38. In the report of the Council, it was stated that there has been an increase in membership during the year of 149, the total membership now standing at 576, more than half the members residing in the United States. The 300 signed copies of the "Collected Papers of Rhys Jenkins" have nearly all been sold, and Extra Publication No. 4, "John Smeaton's Diary of his Journey to the Low Countries 1755", is in the Press. The financial position of the Society is very satisfactory. After the conclusion of the business a paper was read by Captain F. B. Ellison on "The History of the Hay Railway, 1810-1864". This line, more than 25 miles long, was one of the longest of the pre-steam railways. It was built mainly for the conveyance of coal to a district north of Hereford, hitherto served by pack horses. Its terminus was on the Usk at Brecon, to which a canal had recently been made. First surveyed in 1810, the proposal for a railway, or rather tramway laid with iron rails, met with immediate support, among the contributors to the funds being the Earls of Oxford and Ashburnham, the Duke of Beaufort and Viscount Hereford, who was the chairman of the company. An Act of Parliament for the line was obtained in 1811, and tenders were soon afterwards accepted for 2,800 tons of "Cheltenham tram road plates of strong bodied pig iron to be 50 lbs. per plate" and for 20,000 stone blocks weighing 168 lb. each for sleepers. There were several bridges on the line and one tunnel 600 yards long, this being constructed by a miner of Newnham, Gloucestershire. The tramway continued to serve the district until the formation of the Hereford, Hay and Brecon Railway, which bought up the line, sold the tram plates and used the stone sleepers in its bridges; but recently some of the material has been found in good preservation, and many old documents and plans have been brought to light. These are now being preserved in Hereford Museum.

University College, London: Extension of Buildings

UNIVERSITY COLLEGE, London, by the official opening of a further portion of the Foster Court buildings, has reached another milestone in its development. A previous stage of the Foster Court scheme was marked by the opening of the new Department of Zoology by the Chancellor of the University, the Earl of Athlone, in 1933. The chairman of the University Court, Lord Macmillan, opened on December 1, the sections of the general scheme which have recently been completed. These comprise primarily the housing of the Faculty of Laws, the Department of Geography, the Junior Laboratory of the Department of Physics, the Cast Gallery of the Department of Archaeology, and a library centre for the Foster Court departments. By the terms of the endowment of the Yates-Goldamid chair of geology and physical geography, the work in physical geography is undertaken in the Department

of Geology. The special task of the Department of Geography is to promote the study of regional and human geography. Hence, the main feature of the design and equipment of the new department is the emphasis placed on maps and on facilities for their study. The Map Laboratory is a spacious room, with natural lighting on three sides, and artificial lighting provided both by ceiling and by adjustable drawing-bench lamps. Adjoining the laboratory is the map store, where the 3,000 maps which form the existing collection of the Department are conveniently housed. A large lecture room, with epidiascope, a smaller classroom, and a small research room with mapping frames, are all on one floor. The private rooms of the staff and the library are on lower floors. The removal of the Departments of Botany and Geology to the parts of the Foster Court territory which have been allocated to them is still a task of the future.

Pontifical Academy of Sciences

THE first annual report of the reconstituted Pontifical Academy (*Annuario della Pontificia Accademia delle Scienze*, 1; 1936-37) has been received. The origin of this Academy, in common with that of the Royal National Academy of the Lincei, can be traced back to the foundation in 1603 by Federico Cesi of the ancient *Accademia dei Lincei*. Founded in Rome with the object of uniting together those interested in the study of the sciences, the Academy adopted the title "of the lynxes" from the supposed sharp-sightedness of those animals. Many of the most famous men of science of the period became members, amongst them Galileo, who received much support from the Academy. Soon after the death of Cesi in 1630, the activities and influence of the Academy declined, but several attempts at revival were made during the next hundred and fifty years. These efforts had no lasting success, however, until about 1800, when there was a greatly increased activity due mainly to the exertions of Abbot Scarpellini, encouraged by Papal support. Shortly after Scarpellini's death the Academy came under the direct control of the Pontiff, and in 1847 received from Pius IX the title of *Pontificia Accademia dei Nuovi Lincei*.

With the capture of Rome in 1870, the new Italian State took over the major part of the Academy's activities, including its library, and formed the *Reale Accademia dei Lincei*. The Pontifical Academy continued to exist as a separate body, but with greatly decreased influence. In 1936, Pius XI decided to restore the importance of the Academy and reconstituted it under its present title. The Papal Academy of Sciences now consists of seventy academicians, chosen from among the most distinguished men of science, irrespective of nationality and of religious profession. Actually thirty-six of the members are non-Italian and are representative of thirteen nationalities. The British members are Sir Charles Sherrington and Prof. E. T. Whittaker; the late Lord Rutherford was also a member. The Annual,

which extends to more than 800 pages, contains a brief survey of the Academy's history, a description of its headquarters, the Villa Pia, in the Vatican, and biographical notes and portraits of each of its seventy members.

Agricultural Education

BOTH the need and the difficulty of instructing the farmer in the practical results of scientific research are well appreciated by many agricultural authorities, but few seem to have been so enterprising as the Bacon Development Board, which has sent to us some specimens of its recent publications. The Board has realized that it is at least as important to 'put over' new information to those concerned with advising and educating the farmer as to approach him directly. The agricultural county organizer, like many other expert technical men, is far too busy to read all the original literature, to select from it and make the necessary summaries, and it must therefore be a great boon to him to receive ready-made such summaries and abstracts as are now provided by the research department of the Bacon Development Board. These abstracts, which are issued yearly by the Board in the form of a report, are exceedingly well done: clear, concise and well selected. There are only about one hundred of them, but they are all to the point and make attractive reading, even to the non-expert. Included in the volume (Report No. 7, *Selected Abstracts on Pig Production*, Bacon Development Board, Sept., 1937, price 2s. 6d. post paid) are a thumbnail summary of recent developments, a classified table of contents, and lists of the publications of the Board and of the journals from which the abstracts have been made. Reprints of two outstandingly important scientific papers on pig production have been circulated, as well as brochures on round-worm (*Ascaris lumbricoides*) and the ineconomy of feeding too much protein to pigs. These brochures are not written to 'boost' any product or to subserve any private gain, and therefore they are far more likely to hit the mark than the propaganda efforts of commercial undertakings.

The Norman Lockyer Observatory

IN presenting the annual report and accounts (1936-37) of the Norman Lockyer Observatory, the council thanks the new director (Mr. D. L. Edwards) and his small staff for the work carried out under the difficult conditions consequent upon the death of the late director, Dr. W. J. S. Lockyer. Reference is made to the new sensitometer recently added to the equipment of the Observatory, which will make possible the development of quantitative work at Sidmouth over a wide range of the spectrum. Through the generosity of Sir Robert Mond, Prof. F. I. Blumbach is working at the Observatory as a research associate. The council expresses its view that the best tribute that could be paid to Dr. Lockyer's devoted services would be in the development of the Observatory, which retains so many marks of his attention, care and vision.

Acquisitions of the British Museum (Natural History)

THE Department of Geology has recently acquired, through the generosity of the Medical Committee of the Royal Dental Hospital, a molar tooth of Neanderthal man discovered in Genista Cave, Gibraltar, in 1865 by Capt. F. Brome, governor of the Military Prison. The most interesting recent acquisition in the Department of Minerals is a gilt brass model of a gold nugget from the foot of Croghan, Kinshela, near Arklow in County Wicklow. The original nugget was found in 1795. It was said to have weighed 22 ounces and to have been given to King George III by Abraham Coates in 1796. A model is preserved in Trinity College, Dublin, and a plaster model was presented to the British Museum in 1910. The new model is presented by Lord Seaton. Two fine specimens of hydromuscovite with pyrite and arsenopyrite from the Roman Deep Mine, Ogofau, Carmarthenshire, and specimens of a New British mineral, russellite, a mixed crystal of bismuth and tungstic oxides, from Cornwall, are the most interesting of the other British additions. Natural glasses of problematical origin generally classed as tektites continue to appear in various parts of the world. Through Dr. Spencer, forty-eight specimens of natural glass from Java have been presented by Dr. G. H. R. von Koenigswald. Prof. Suess of Vienna has presented a piece of the so-called köfelsite—a fused gneiss from the supposed meteorite crater at Köfels in the Austrian Tyrol. The Department has acquired by purchase some fine groups of cassiterite from Bolivia from Messrs. Gregory and Bottley and has also secured the greater part of the collection of Hugh Septimus Gordon, who specialized in collecting and studying the minerals of the rare earths.

Excessive Marine Growth in Shoreham Harbour

A SHORT time ago a letter appeared in the Press stating that coral was growing in the Southwick basin of Shoreham Harbour, Sussex, and was causing considerable trouble by fouling the bottoms of yachts and small boats lying in this part of the harbour. The Southwick canal, or basin, is looked off from the rest of Shoreham Harbour, its waters being kept at a constant level and free from tidal rise and fall. The sea water in the basin is used to cool the condensers of the Brighton and Hove electric power station, which is situated on its seaward side with coal wharves on the basin. Being of limited area, the water in the basin is appreciably warmed by this means, and is said not to fall below a minimum of about 65° F. At first this growth was thought to be a tropical reef-building coral which had somehow managed to survive the passage from Pacific or West Indian seas on the bottom of a yacht about a year ago, and was able to thrive in the comparatively warm waters of the basin.

THE British Museum (Natural History) was asked to investigate, and Mr. Dilwyn John is at present collecting specimens of the local marine fauna and flora living under the peculiar conditions occurring in the Southwick basin. The 'coral' turned out to

be an excessive growth of a polychaete worm, closely resembling *Hydroides norvegica* Gunnerus (Serpulidae), which lives in tubes of a calcareous nature. It is possibly a species new to science, and is being described by Mr. C. C. A. Monro of the British Museum (Natural History). The growth consists of dense brittle clusters of the white tubes of this worm, which grow to approximately 9 cm. long and average 1 mm. in diameter, and are usually cemented one to another. It occurs more frequently around the water-line of floating objects than on piles or the keels of boats, which appears to indicate that light and aeration are favourable to its growth; but the warm water of the Southwick basin seems to be the chief cause of its present excessive development. Perhaps after a full investigation other less conspicuous marine organisms may be found to be behaving in a peculiar manner on account of the interesting conditions occurring in this part of Shoreham Harbour.

Registration and Population Trends

A PAPER read by Dr. R. R. Kuczynski before the Eugenics Society on future trends in population is published in the *Eugenics Review*, 29, No. 2. He points out that in 1837 an Act was passed for registering births, deaths and marriages in England, more than sixty years after such demographic data were recorded in Sweden. His address is mainly devoted to showing the inadequacy of the records as kept in Great Britain compared with those of various other countries, our original birth and death registration forms having remained unaltered up to the present time. The age of the mother at the birth of each child was recorded in Sweden so early as 1774, and in 1839 the Compiler of Abstracts in the General Register Office wrote a letter to the Registrar-General pointing out two grave defects in the records, but nothing has been done. The need is stressed particularly for recording the age of the parents, especially the mother, at the birth of each child, the order of birth and the duration of the marriage, as well as the date of birth. Without such data it is impossible to determine questions of differential fertility and population growth or decline. Various suggestions are made, including that of a special fertility census in December 1938. We should then have within three years a fair knowledge of present fertility trends, on which a Government population policy could be formulated with some chance of success.

Conference on Atmospheric Pollution

THIRTY-SIX representatives of local authorities and other organizations co-operating with the Department of Scientific and Industrial Research met on November 29 in the half-yearly conference. Dr. G. M. B. Dobson, chairman of the Atmospheric Pollution Research Committee, presented the report on the progress of the investigations carried out under the Committee. He spoke in particular of the results which are being obtained in the special survey which is in progress in and around the City of Leicester. Two sources of atmospheric pollution which occur in

certain districts were also discussed. It was agreed that a letter be addressed to the Ministry of Health protesting against the continuation of nuisance arising from burning colliery spoilbanks and urging that action be taken to end it. It was also agreed by the representatives to ask the Department of Scientific and Industrial Research to consider and report on the possibility of research being undertaken to develop remedial measures to prevent nuisance caused by zinc oxide fumes in certain stages of the manufacture of brass.

Chronica Botanica

FROM February 1938, *Chronica Botanica* will be issued bi-monthly and no longer as a yearbook. The annual subscription will be reduced from 15 to 7 guilders. The new periodical will continue to give all the essential information which was given in the old yearbook and will include some important new sections. Results of research will be published only in the first two sections. The world list of plant science institutions and societies will appear as an annual supplement. The reorganized *Chronica* will contain short preliminary notes on the results of recent research or announcing new discoveries; discussions, announcements, letters to the Editor; detailed programmes, short reports, decisions, resolutions of international congresses; quotations from recent articles of general and timely interest; personal notes and queries; short reviews of new botany books, etc. The address is P.O. Box 8, Leyden.

Anti-Gas Training and Defence

THE Home Office has published a memorandum summarizing in convenient form the more important information that has already been issued in various circulars of the Air Raid Precautions Department (Air Raid Precautions, Memorandum No. 5. London: H.M. Stationery Office. 4d. net). It outlines the suggested organization and arrangements for local anti-gas training. For districts where no gas chamber is available for the training, the Home Office has provided a fleet of 40 motor 'gas vans', by means of which instruction is given in the use of the respirator in an atmosphere of tear gas. In a report, just issued, describing experiments conducted by the Chemical Defence Committee with the object of testing the recommendations made by the Air Raid Precautions Department, it is concluded that sealing a room in the manner suggested, and the use of a gas-mask of the pattern which is being prepared, will give a high standard of protection against aerial gas attack.

Announcements

MR. C. FORSTER COOPER, F.R.S., director of the University Museum of Zoology, Cambridge, and reader in vertebrate zoology in the University, has been appointed director of the British Museum (Natural History) in succession to Dr. C. Tate Regan, F.R.S., who retires on February 2, 1938. Mr. Forster Cooper's zoological work has been concerned mainly with the vertebrates, both recent and fossil.

THE Medal of the Institution of Mining Engineers has been awarded to Dr. Carl Beyling, director of the Experimental Station at Dortmund-Derne, in recognition of his services in the application of scientific knowledge and research to safety and health problems in coal-mining, and to Dr. R. V. Wheeler, professor of fuel technology in the University of Sheffield and director of the Safety in Mines Research Board Experimental Stations at Sheffield and Buxton, in recognition of his services in the application of scientific knowledge and research to problems of safety and health in coal-mining, and of the utilization of coal.

MR. D. P. COSTELLO, of Trinity College, Cambridge, has been awarded the Royal Asiatic Society's Universities Essay Prize for 1936-1937. The subject of his essay was "The Relations of the Greeks with the East". The other essays submitted were of such a high standard that the Council of the Society is also awarding a special second prize to Mr. John Bowman, of the University of Glasgow, for his essay on the alternative subject "Tamerlane".

PROF. A. S. EVE has undertaken the preparation of the authorized life of Lord Rutherford of Nelson, and it is to be published when completed by the Cambridge University Press. It is earnestly requested that any correspondents who have letters, written by Lord Rutherford, which throw light on his life and work, will forward them as soon as possible to Prof. Eve, 26 Willow Road, Hampstead, N.W.3. Original letters will be promptly returned if requested.

APPLICATIONS are invited for the David Anderson-Berry Gold Medal, together with a sum of money amounting to about £100, which will be awarded in July 1938 by the Royal Society of Edinburgh to the person who, in the opinion of the Council, has recently produced the best work on the nature of X-rays in their therapeutical effect on human diseases. A similar award will be made every three years. Further information can be obtained from the General Secretary, Royal Society of Edinburgh, 22 George Street, Edinburgh, 2.

THE following have been elected officers for 1937-38 of the University of Durham Philosophical Society: *President*: The Very Rev. C. A. Alington; *Hon. General Secretary*: Dr. W. A. Clark; *Hon. Treasurer*: Mr. J. W. Bullerwell; *Editor*: Prof. G. W. Todd; *Assistant Editor*: Mr. J. F. Wood; *Hon. Librarian*: Mr. E. Patterson.

THE annual meeting of the Science Masters Association will be held in the Chemistry Department of the Imperial College of Science and Technology on January 4-7. Sir Cyril Ashford will deliver his presidential address entitled "Past and Future Aims of School Science" on January 4. Further information can be obtained from Mr. R. E. Williams, 15 Norham Gardens, Oxford.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 975.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Relation between 'Fibrous' and 'Globular' Proteins

ON various occasions in NATURE and elsewhere it has been argued that the elastic fibrous proteins, keratin and myosin, by virtue of the system of intramolecular folds which appears to be their characteristic stereochemical feature, are the linear prototype of the globular proteins, which presumably are constructed to similar principles but in two or three dimensions¹. Direct experimental support for this view comes from X-ray studies of the denaturation of the globular proteins, which show that the change always results in the appearance of polypeptide chains, which can often be drawn out into artificial fibres analogous to β -keratin or β -myosin². It has also been recognized for some time that feather keratin³ in particular is to X-rays really both fibrous and globular, and more recently the early observation of long spacings in the keratins has been supplemented by the discovery of even longer spacings in these and other protein fibres⁴. The tobacco mosaic virus⁵ is another protein which has properties both fibrous and globular*—and, to cut a long story short, it looks now as if the original apparent distinction between the two types is beginning to disappear. One possible way, based on density and other considerations, of deriving a general scheme directly from keratin⁶ amounts actually to building up molecules having essentially the structure deduced from X-ray data for the keratin crystallites, and this suggests at once the idea that the protein fibre crystallites and the tobacco virus units fall into the same category.

The recent work of Bergmann and Niemann⁷ also indicates that both fibrous and globular proteins are constructed to a common plan, or at least that some common factor is involved in their method of synthesis. Bergmann and Niemann conclude that both the total number of amino-acid residues in a protein molecule and also the numbers of each of the various residues are expressible in the form $2^n 3^m$. On this basis, the minimum molecular weights of chicken egg albumin, cattle haemoglobin, cattle fibrin, and silk fibroin are found to correspond to 288 , 2×288 , 2×288 , and 9×288 residues respectively, which is equivalent to saying that *chemical analysis places not only two globular proteins—which would be expected—but also two fibrous proteins in one and the same scheme of multiple molecular weights*, the Svedberg scheme in fact, founded on ultracentrifugal studies of the globular proteins.

Now X-rays offer a way of supplementing the Bergmann argument, which requires a knowledge of the average residue weight, though there is no way of knowing this directly by chemical means owing

to incomplete analyses. For β -keratin, for example, the average residue weight can be calculated from the density (for an estimate of the density of β -keratin I am indebted to Mr. H. J. Woods) and the X-ray measurements of the average residue dimensions. The best available data make it equal to $(9.7 \times 4.65 \times 3.33 \times 1.3)/1.65$, or about 118, corresponding to approximately 0.85 gram-residues per 100 gm. of keratin. The number 0.85, when divided by values of $2^n 3^m$, should give the numbers of gram-residues of the various acids in 100 gm. of keratin. The accompanying table shows the results, to be discussed elsewhere, of the calculations for wool keratin:

Acid		Frequency	Gm.-res. in 100 gm. wool	
			Calc.	Obs.
A—	Glutamic	8 (2 ³)	0.106	0.103
	Arginine	16 (2 ⁴)	0.053	0.059
	Aspartic	16 (2 ⁴)	0.053	0.054
	Tyrosine	32 (2 ⁵)	0.027	0.027
	Lysine	48 (2 ⁴ .3)	0.018	0.019
	Tryptophane	96 (2 ⁴ .3)	0.008	0.009
	Histidine	192 (2 ⁴ .3)	0.004	0.004
B—	Amide-N	9 (3 ²)	0.094	0.098
C—	Cystine†	8 (2 ³)	0.106	Mean value
	Methionine	192 (2 ⁴ .3)	0.004	Mean value
D—	Leucine	9 (3 ²)	0.094	0.088
	Alanine	16 (2 ⁴)	0.053	0.050
	Proline	24 (2 ⁴ .3)	0.035	0.038
	Serine	32 (2 ⁵)	0.027	0.028
	Valine	36 (2 ⁴ .3)	0.024	0.024
	Glycine	96 (2 ⁴ .3)	0.008	0.008

† Calculated as half-cystine residues.

It will be seen that the measure of agreement is quite good, and though it is difficult yet to prove that only powers of 2 and 3 are involved, there is sufficient evidence to warrant the belief that keratin also will be found to conform to the common stoichiometric plan. The following points may be noted with regard to the experimental data presented: (A) These are the most reliable, and require a molecule containing a minimum of 192 residues, including 17 basic residues. The equivalent weight comes to about 1,330, which agrees reasonably well with the estimate (about 1,250) given by acid absorption⁸. (B) If the number of amide groups is also a submultiple of the total number of residues, which is not unlikely, the latter would then be at least 2×288 (mol. wt. about 68,000), corresponding to haemoglobin and fibrin. (C) The variable sulphur content of the keratins is a difficulty at the moment, for the cystine values do not fall into a limited number of groups corresponding to $1/6$, $1/8$, $1/9$, etc., as might be expected, though the mean estimates, both for cystine and methionine, agree roughly with the theory. It might be argued that there is a mixture of proteins each obeying the same law, but in that case there is going

* I am under the impression that I am responsible for the original use of the word 'globular' in discussing protein types¹; but of course it was never meant to imply the spherical shape only, but rather something bulky, as opposed to an extended molecular chain like cellulose.

to be trouble all round, and any number, whether belonging to the series $2^m 3^n$ or not, could be claimed to fit the theory. It may be, though, that this really is the correct general solution, that the numbers of amino 'sites', as in alloys and mixed crystals, are expressible in the form $2^m 3^n$, or whatever the law should turn out to be. The law would then be directly apparent in ideal or limiting cases only. (D) These data are probably unreliable.

In explanation of their results, Bergmann and Niemann propose the hypothesis that "in every protein each amino acid residue is distributed throughout the entire peptide chain at constant intervals. The protein molecule therefore contains a great number of superimposed frequencies". But is not this impossible? The periods 8 and 9, for example, must 'clash' before we come to 72; and in general such a hypothesis involves more than one residue occupying the same place in the peptide chain. Again, Bergmann says¹⁰, "The presence of so complicated a periodicity explains why the problem of X-ray photography is so different for proteins than in the case of substances with simple periodicity". But is it?

However, quite apart from these questions, it seems clear that we are now on the fringe of something very fundamental indeed in protein theory, and the moral value alone of Bergmann and Niemann's discoveries will be immense. Exact analyses of the proteins, though always laborious, need no longer be the thankless tasks they have been. There is a goal in sight.

I should like to express my indebtedness to Dr. J. B. Speakman and Prof. A. C. Chibnall for advice on chemical points.

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Nov. 8.

¹ Astbury, W. T., and Lomax, R., *NATURE*, **135**, 795 (1934). See also *NATURE*, **137**, 803 (1936); *Chem. Weekbl.*, **53**, 778 (1936).

² Astbury, W. T., and Lomax, R., *J. Chem. Soc.*, 846 (1935); Astbury, W. T., Dickinson, S., and Bailey, K., *Biochem. J.*, **20**, 2351 (1936).

³ Astbury, W. T., and Marwick, T. C., *NATURE*, **130**, 309 (1932); Astbury, W. T., *Trans. Farad. Soc.*, **29**, 198 (1933); *Kolloid-Z.*, **60**, 340 (1934); *Chem. Weekbl.*, **53**, 778 (1936).

⁴ Clark, G. L., et al., *J. Amer. Chem. Soc.*, **57**, 1509 (1935); Corey, R. B., and Wyckoff, R. W. O., *J. Biol. Chem.*, **114**, 407 (1936).

⁵ Bawden, F. C., Pirie, N. W., Bernal, J. D., and Fankuchen, I., *NATURE*, **133**, 1051 (1936); Bernal, J. D., and Fankuchen, I., *NATURE*, **139**, 623 (1937); Best, R. J., *NATURE*, **139**, 628 (1937); **140**, 547 (1937).

⁶ Astbury, W. T., *NATURE*, **137**, 803 (1936).

⁷ Bergmann, M., and Niemann, C., *J. Biol. Chem.*, **115**, 77 (1936); **118**, 801 (1937); *Science*, **86**, 187 (1937).

⁸ Speakman, J. B., and Stott, E., *Trans. Farad. Soc.*, **30**, 539 (1934); **31**, 1426 (1935).

⁹ Bergmann, M., and Niemann, C., *J. Biol. Chem.*, **118**, 307 (1937).

¹⁰ Bergmann, M., Harvey Lectures, **31**, 56 (1935-36).

Diffraction of Light by Ultrasonics at Oblique Incidence

It is well known that the first simplified theory of the diffraction of light by ultrasonics, which Sir C. V. Raman and N. S. Nagendra Nath¹ put forward in 1935, explains many experimental facts in a very striking way. The main point of the theory is to neglect the bending of the light-rays in the sound field altogether and to attribute the observed effects wholly to the local variations of the optical length in the sound-wave. If a plane light-wave falls

normally on a sound-wave, the incident wave-front becomes a periodic corrugated wave-front. At oblique incidence it follows from this theory² that the corrugation vanishes for certain angles of incidence φ_n which satisfy the equation

$$\tan \varphi_n = n \frac{\lambda^*}{L}; \quad n = \pm 1, \pm 2, \dots \quad (1)$$

in which λ^* denotes the wave-length of the sound and L the breadth of the sound field; consequently there should be no diffraction spectra visible when the light is incident in any of these directions.

This consequence of the theory has never been verified experimentally. The vanishing of the diffraction effect at these angles of incidence can be seen at once by the use of divergent light and of a suitable optical arrangement (Fig. 1). An image of

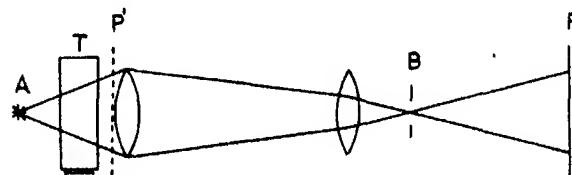


Fig. 1.

a point-shaped light-source A is formed in the plane B . The trough T with the liquid, in which the ultrasonics are generated, is placed in the divergent part of the light-ray. An image of a plane P' behind T is formed on the photographic plate P . On exciting the sound field, a number of diffraction spectra are produced in the plane B , one of which is transmitted by a suitable slit. The intensity distribution of the light falling on P is then an image of the intensity distribution of the light of this diffraction spectrum in P' . The dark bands visible in P correspond to the angles of incidence φ_n for which no diffraction takes place. A photograph, which was taken with sound-waves in water at a frequency of 15,000 kilocycles with a first-order spectrum is reproduced in

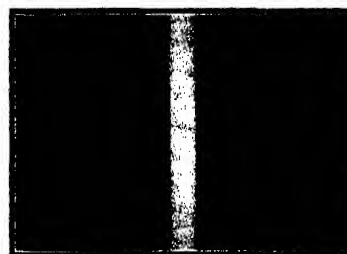


Fig. 2.

Fig. 2. In conformity with the theory, the angles φ_n are independent of the intensity of the sound-wave and the wave-length of the light used. The dependence of φ_n on λ^* is also in accord with equation (1). This has been verified in the range 4-15 thousand kilocycles, that is, for frequencies which are much higher than the domain of validity of this simplified theory with regard to other diffraction phenomena³. The dependence of φ_n on L is also in conformity with (1). The accuracy of these measurements is ± 5 per cent; for more exact measurements, an arrangement using parallel light would be preferable.

If the intensity of the sound is sufficiently high, the superposition of the intensities of all diffraction spectra gives rise to a phenomenon which has recently been described by L. Bergmann and H. J. Goehlich⁴.

It should be emphasized that the experiments can only be carried out with an exactly plane sound-wave. Consequently a piezoquartz from Messrs. Carl Zeiss of Jena was used, which was cut according to the prescription of H. Straubel⁵. With an ordinary quartz plate one gets very distorted figures.

A detailed account of these experiments will appear shortly in *Helvetica physica Acta*.

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¹ Raman, C. V., and Nagendra Nath, N. S., *Proc. Ind. Acad. Sci.*, **2**, 406, 413; **3**, 75.

² *Proc. Ind. Acad. Sci.*, **2**, 413.

³ Bär, R., *Helv. phys. Acta*, **9**, 265 (1936).

⁴ Bergmann, L., und Goehlich, H. J., *Phys. Z.*, **38**, 9 (1937).

⁵ Straubel, H., *Z. Hochfrequenz.*, **38**, 14 (1932).

The Paramagnetic Magnetron Numbers of the Ferromagnetic Metals

THE paramagnetic magnetron numbers of the ferromagnetic elements are derived from the linear portion of the $1/\chi, T$ curves above the Curie point. Of the three ferromagnetics cobalt, iron and nickel, only in the case of one, nickel, is the slope known with any degree of certainty. In the case of iron, Curie point 780°C ., the phase change at 920° so restricts the temperature range over which measurements can be made that the $1/\chi, T$ curve never becomes linear. The high Curie temperature of cobalt at about 1150°C makes precise measurements difficult, largely owing to evaporation and solid diffusion.

We have developed a method using a magnetic balance devised by one of us¹, for measuring accurately susceptibilities up to 1500°C . Evaporation of the specimen is to a large extent eliminated by using an atmosphere of argon at low pressure. The method has been used successfully to measure the magnetron numbers of iron and cobalt, and to extend the temperature range of measurements on nickel.

It is well known that the α and δ phases of iron are identical (body-centred cube), and the intervening γ phase, which persists from 920° to 1390°C ., can be removed by the addition of various metals which are soluble in the iron. The system iron-vanadium was chosen, in which about 5 per cent vanadium removes the γ phase completely. Our experiments show that the $1/\chi, T$ curve is linear above 900°C . The results for three different alloys are given in the accompanying table, from which the extrapolated value for pure iron is obtained. The second column gives the paramagnetic Curie temperature θ , whilst the third column gives the Curie constant per gram $C = \chi(T - \theta)$. In the fourth column are the values of the magnetron number $p = \sqrt{3KC/N\mu^2}$, where K is Boltzmann's constant, N the number of atoms per gram, and μ the Bohr magneton $eh/4\pi mc$. It is worthy of note that the curve in the δ phase of iron (99.97 per cent pure) is linear, and when extrapolated to lower temperatures joins the α phase at the A_4 transformation. The value for the magnetron number thus obtained is in close agreement with the value determined from the alloys.

Our measurements show that the curve for cobalt (99.8 per cent pure) is quite linear between 1230° and 1450°C ., the upper limit of our observations on this metal. It was observed that continued annealing of the (electrolytic) specimens produced parallel but displaced lines on the $1/\chi, T$ graph, usually tending to lower the paramagnetic Curie point. These changes do not affect the Curie constant, whilst the Curie temperature ranges from 1180° to 1155°C .

The results on nickel agree with those of earlier workers up to 850°C ., a linear relationship being followed from 500°C . Above 925°C . the slope decreases, giving a change in the Curie constant from 0.00548 to 0.00685.

A full account of the experiments, together with discussion of the results, will appear elsewhere.

	θ	$C = \chi(T - \theta)$	$p = \sqrt{3KC/N\mu^2}$
Nickel 500°-850° C.	377° C.	0.00548	1.61
925°-	265° C.	0.00685	1.78
Cobalt 1230°-1450° C.	1130°-1155° C.	0.0208	3.15
Iron-Vanadium 5%	828° C.	0.0222	3.16
4.1%	828° C.	0.0224	3.17
2.5%	828° C.	0.0225	3.18
(extrapolated) 0%	—	0.0227	3.20
Iron from δ phase	820° C.	0.0220	3.15

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¹ Sucksmith, *Phil. Mag.*, **8**, 168 (1929); **14**, 1115 (1932).

Joule-Thomson Effect and Quantum Statistics

IN view of the numerous physical and astrophysical applications of the new quantum statistics it may be worth while to investigate the Joule-Thomson effect for a gas obeying Fermi-Dirac or Bose-Einstein statistics. The calculation is simple and runs on the usual lines. The results obtained are quite interesting. It is found that for a degenerate gas, degenerate in the sense of Fermi-Dirac statistics, Joule-Thomson expansion produces a heating effect, the rise in temperature for a given fall in pressure being greater, the greater the degree of degeneracy of the gas. In fact

$$\left(\frac{\partial T}{\partial p}\right)_i \div - \frac{g}{\pi k n} \left(\frac{3A_0}{4\pi}\right)^{1/2} \\ = - \frac{3}{8\pi^2} \left(\frac{4\pi g h^3}{15 m}\right)^{1/2} \frac{h^2}{m k^2 T p^{1/2}} \dots (1)$$

where n denotes the number of particles (each of mass m) per unit volume, p the pressure, T the temperature, g the weight factor (for electrons $g = 2$), k the Boltzmann constant and h is Planck's constant. A_0 is called the "degeneracy discriminant" and its value gives a measure of the degree of degeneracy (or of non-degeneracy in the case of non-degenerate gas).

$$A_0 = \frac{nh^3}{g(2\pi m k T)^{3/2}}$$

For degeneracy $A_0 \gg 1$, and in non-degeneracy $A_0 \ll 1$.

It may be remarked for comparison that an adiabatic expansion produces cooling. In fact, as is easily seen, during an adiabatic process a degenerate

gas will remain degenerate and a non-degenerate gas will remain non-degenerate, the value of A , remaining constant during the process.

In the case of *non-degeneracy*, the Joule-Thomson effect is given by the relation

$$\left(\frac{\partial T}{\partial p}\right)_i = -\frac{\beta A_s}{2^{1/2}nk} \\ = -\frac{\beta h^3}{2^{1/2}g(2\pi m)^{3/2}k^{5/2}T^{5/2}} \dots (2)$$

where β is to be taken as $+1$ for a gas obeying Fermi-Dirac statistics and as -1 for a gas obeying Bose-Einstein statistics. It is of interest to note that the Joule-Thomson effect is independent of the pressure, and further it vanishes only when $T \rightarrow \infty$.

In order to illustrate the order of magnitude of this effect, let us take the case of helium at 5°K . Helium obeys Bose-Einstein statistics and hence, taking $\beta = -1$ and substituting numerical values for the quantities involved, we find

$$\left(\frac{\partial T}{\partial p}\right)_i = 0.076^\circ/\text{atmos.}$$

However, this will not represent the thermal effect actually observed, which will depend largely upon the Van der Waals' type of deviations from the classical perfect gas. It is difficult to estimate exactly the contribution due to Van der Waals' deviations, but if we use the ordinary formula¹ to obtain some idea of it, we find (taking Van der Waals' $a = 0.034 \times 10^6$ atmos., $b = 23.7$ cm.³) a value of $0.7^\circ/\text{atmos.}$ for helium at 5°K . The Van der Waals effect is much the larger, but the statistical effect is still 10 per cent of it. It therefore seems possible that the Joule-Thomson effect under suitable conditions may provide an experimental test of the statistics obeyed by gases, say, helium.

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Oct. 14.

¹ Saha and Srivastava, "A Treatise on Heat", 476 (1935). We use the approximate equation in which the term $\frac{2a}{RTV}$ is supposed small compared to unity.

Interpretations of Atomic Constitutions

PROF. ANDRADE has had the great courtesy to attempt to answer my two questions in NATURE of November 20, they are:

(1) Whether the theory of the electrical composition of matter now fails.

(2) The difficulty of the nucleus tightly packed with protons.

Prof. Andrade avoids my first question in the most accomplished parliamentary form, telling me that in future I must not look on electricity as a fluid, and ask for a pot, pint, or firkin thereof. Interesting and informative, but the position is that the physicists announced to the world the electrical composition of matter. I did not do it. Why should I be lectured? Now when the non-electrical neutron is established I ask a simple question: Have they been talking nonsense or not? The general impression I get from Prof. Andrade is that they have. If so, the sooner they announce it the better.

Now as to the nucleus.

Prof. Andrade, when I get him into a difficulty over the protons packed together, answers with the readiness of a cash register, "No charge". But I notice the charge, with its defensive field, is still there to account for the superior penetration of the neutron over the proton in hitting and disintegrating the nucleus in bombardment.

Apparently the physicist changes the conditions at any time he likes to suit his convenience, but you cannot have it both ways. The quotation from Rutherford seems to me extremely sane, to the point, and logical. Referring to the nucleus he says it is "held together by very powerful unknown forces". If everyone was as frank as that and confessed to difficulties instead of riding round them, the popular explanation of modern physics would be no less attractive and a good deal clearer.

I hope these somewhat harsh words in debunking the physicists will not be construed as an attack on Prof. Andrade. Alone, valiantly he has come forth to break a lance with me and I respect and admire him for it. In his concluding paragraph he asks me for information on one of my subjects, namely, foreign policy, over the last ten years. It being near Christmas time, mutual help seems only seasonable.

Macroscopic events, ethnical considerations, and crowd psychology are subjects that the simple physicists will not understand, therefore I will try to tell the story in their own language.

Europe may be looked upon as a nucleus composed of individual protons, not however all of the same size or power, mixed up with a few neutrons with no charge and little mass. This is kept together by a strong force which prevents them flying apart, known as geography. This nucleus is not symmetrical as, included on its western edge, is a particularly powerful proton¹ that has "wave characteristics" of a definite type peculiar to itself. In the south there is what might be called a neutrino². This has, some think, also wave mechanic aspirations. It is peculiar in this respect that its core is eternal³ but its surround, some think, is ephemeral.

Now the real trouble is that just as in the atom there are electrons in their orbits far away from the nucleus, so in this case there are colonies also revolving. These used to be attached, so to speak, to separate protons, but some years ago the nucleus was subjected to a terrific bombardment which shifted these electrons from belonging to one proton to another. One very powerful proton, in mathematical language generally designated thus $\frac{1}{2}$, suffered severely in this respect, with the result that the nucleus as such is no longer stable. It has been found, however, that if the western proton adds to its charge⁴, although a state of strain between the two protons is introduced, the nucleus qua nucleus becomes more stable.

I hope I have put this very difficult problem in simple terms for the physicists. I would have liked to have said a word on Newton's laws of gravity, as Prof. Andrade mentions them, but I feel that you, sir, must have your own laws on the same subject and that I am straining them.

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¹ Britain.

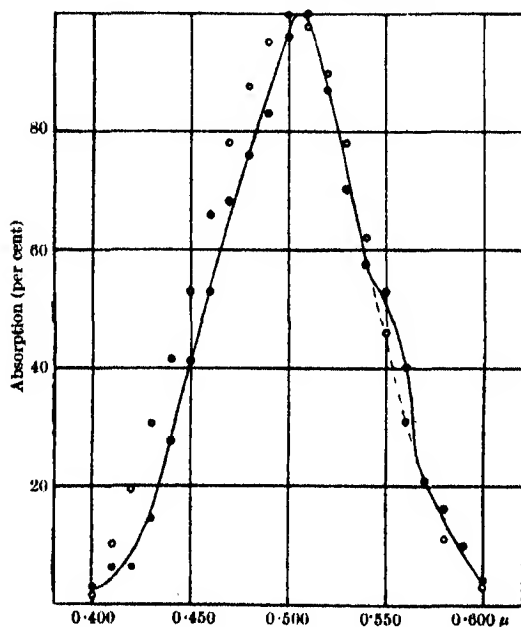
² Italy.

³ Rome.

⁴ By re-arming.

Absorption Curve for Visual Purple and the Electrical Response of the Frog's Eye

LETTERS in NATURE by Dartnall and Goodeve¹ and by Wald² have revived the question concerning the physiological significance of visual purple and visual yellow. Dartnall and Goodeve discuss the scotopic luminosity curve and compare it with the absorption curve for amphibian visual purple, determined by Lythgoe³. Attention may perhaps be directed to the fact that the retinal equivalent of the frog's luminosity curve has been measured by Granit and Munsterhjelm⁴ with the aid of the electrical response. In this work, 'luminosity' was obtained in terms of the amount of potential in millivolts of the initial positive b-deflection of the electroretinogram in response to stimulation with an equal energy spectrum.



We lacked then, and still lack, data showing the relation between amount of potential and energy absorbed (intensity), and therefore had to neglect the area of the curves showing size of b-wave against wave-length. However, recent interest in this problem may to some extent be satisfied by a calculation of the frog's 'luminosity' curve, that is, the physiological absorption curve, on the basis of the fact that at low intensities, such as were used by Granit and Munsterhjelm, the b-wave according to Chaffee, Bovie and Hampson⁵ is proportional to the square root of the intensity. This is a general equation that probably will not hold for all the twenty-seven somewhat differently distributed 'luminosity' curves measured by Granit and Munsterhjelm. But it should be acceptable if their 801 values are averaged together.

Applying the equation of Chaffee *et al.* to the average curve of Granit and Munsterhjelm (their Fig. 7) we obtain the effective intensity from the amount of potential at each wave-length. The effective intensity must be proportional to energy absorbed. Finally, following Dartnall and Goodeve, we correct the absorption curve computed from the electrical responses by multiplying by the value of the quantum at each wave-length. This gives us curve above.

The dots represent the 'physiological' absorption curve, the circles around it Lythgoe's curve for the absorption of visual purple in solution (his Table 1, column 2). Both curves refer to *Rana esculenta*. The hump in our curve between 0.550–0.560 μ is placed at the maximum of the cone curve of the same species, determined after light adaptation with the same apparatus by Granit and Wrede⁶. It probably signifies that in this region of maximal cone sensitivity some low threshold cones have succeeded in influencing the measurements. However, the main result is obviously that there is a reasonably good fit in the long wave-lengths, but that even the 'corrected' absorption curve for visual purple, used for comparison, is higher in the short wave-lengths.

Dartnall and Goodeve, coming to the same conclusion, prefer Lythgoe's uncorrected values and suggest that the greater absorption by visual purple in the short wave-lengths is due to 'yellow impurities'. Their comparison refers to the human scotopic luminosity curve. This may be the correct explanation of the discrepancy, so far as measurements of electrical responses at low intensities or human absolute thresholds are concerned. But it is an interesting and, perhaps, significant fact that we obtained a hump at about 0.460 μ when the scotopic eye was stimulated with a brighter spectrum (Granit and Munsterhjelm), and that the otherwise symmetrical cone curve had an 'appendix' of relatively too large responses in the same region (Granit and Wrede). It should be a relatively easy task to determine by means of the electrical responses whether all the yellow substances are internal filters or some perhaps physiologically active photochemical substances.

We hope to be able to publish such measurements in due course.

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¹ Dartnall and Goodeve, NATURE, 130, 409 (1937).

² Wald, NATURE, 139, 587 (1937).

³ Lythgoe, J. Physiol., 89, 331 (1937).

⁴ Granit and Munsterhjelm, J. Physiol., 88, 486 (1937).

⁵ Chaffee, Bovie and Hampson, J. Amer. Opt. Soc., 7, 1 (1923).

⁶ Granit and Wrede, J. Physiol., 89, 239 (1937).

Effect upon Sex Behaviour of a Diet Deficient in Vitamin E

DIETS deficient in vitamin E produce sterility in the male rat and ultimately extinguish the sex drive^{1,2}. Preliminary observations suggested that the behavioural disturbances were not clearly related to, and dependent on, genital degeneration. Extended tests were therefore undertaken on 76 male rats reared on a diet lacking in vitamin E but adequate with respect to vitamins A and D and containing sufficient yeast.

Behaviour differed greatly. In some animals sex behaviour was normal during the first months of the experiment. In others it was disturbed during this period, the abnormalities resembling those described as a result of partial hypophysectomy³. In about 25 per cent of the animals no overt sex behaviour was observed at any time. As the experiment progressed, disorganization of sex behaviour took place in those animals which mated during the first stages of the experiment. Both structure and intensity of behaviour were affected; the males mounted but failed to complete the sex act.

Maturation of the glans penis and activation of the accessory genital glands took place in all animals. After disorganization of sex behaviour had become apparent, fairly large quantities of gonadotropic hormone prepared from pregnancy urine were administered and resulted in excessive development of the genital glands. Yet this hormone failed to evoke normal sex behaviour. Gonadotropic hormone prepared from the urine of an oophorectomized woman was similarly ineffective. But gonadotropic extract prepared from the blood of a pregnant mare invoked mating in 60 per cent of inactive males within three to five days. The same effect was obtained with some aqueous anterior lobe extracts.

The results of the present study resemble those obtained in experiments on total and partial hypophysectomy. Total ablation of the pituitary extinguishes sex behaviour, partial ablation is apt to produce disturbances of structure and/or intensity of the drive. The resemblance between animals reared on an E-deficient diet and hypophysectomized males respectively extends to the effect of suitable extracts: these restore sex behaviour in either group. It would appear, then, that the dietary deficiency affects sex behaviour by disturbing the erogenous function of the anterior pituitary. It is also interesting to note that since the completion of this work Miss M. M. O. Barrie⁴ has published evidence of hypopituitarism produced by vitamin E deficient diets in rats and their offspring.

The procedure used in these experiments makes it possible to eliminate the erogenous function of the pituitary without surgical ablation and the consequent cachexia, stasis of growth and other general adverse effects. But it should be added that the deficiency produced in these experiments may not be wholly referable to the absence of vitamin E; some other deficiency may have existed, since we were not successful in obtaining normal sexual behaviour by addition to the basal diet of vitamin E (wheat-germ oil or its concentrates). Since disorganized sex behaviour was observed even in males whose basal diet was supplemented with vitamin E from weaning onward, failure to repair the defect cannot be attributed solely to irreversible changes produced by vitamin E deficiency.

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¹ Evans, H. M., and Bishop, K. S., *Anat. Rec.*, **99**, 447 (1922).

² Mason, K. E., *Am. J. Physiol.*, **95**, 64 (1933).

³ Wiesner, B. P., and Sheard, N. M., *NATURE*, **132**, 641 (1933).

⁴ Barrie, M. M. O., *NATURE*, **139**, 336 (1937); **140**, 426 (1937), *Lancet*, **ii**, 251 (1937); *Chemistry and Industry*, Proc. Biochem. Soc. **58**, 1053 (1937).

Protective Effect against Experimental Rickets of Rats of a Single Massive Dose of Vitamin D

It is a well-known fact that there is a very wide margin between the therapeutic and toxic doses of vitamin D. It may safely be stated that a thousand times the therapeutic dose is quite harmless, at least for rats. It seemed to be worth while to investigate whether such a large dose if given intramuscularly would render rats immune against rickets for a long period.

Two pairs of young rats were placed on the rachitogenic diet McCollum No. 3143. To each of

the first pair 750 international units of vitamin D were injected intramuscularly, while the other pair remained untreated. X-ray photographs were taken at weekly intervals. The rats were weighed weekly.

Of the pair given the vitamin D injection, one remained free from any signs of rickets for eight months (died accidentally), the other for 14 months (end of the investigation). Their weights increased from the initial 40 gm. to about 165 gm., which can be looked upon as normal, taking into consideration that the animals were kept continuously on the restricted diet McCollum No. 3143. The control rats showed the usual picture: after two weeks on the rachitogenic ration, severe rickets developed, after five to six weeks, decline of weight began and the animals died within three months.

The experiment shows that a single massive dose of vitamin D given as an intramuscular injection, was able to protect rats living on a rachitogenic diet from rickets.

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Trisomic Mutations in Jute

Corchorus capsularis Willd., the common jute plant, has usually 14 chromosomes in the diploid state. No other number has been reported in the species or varieties of jute.



Fig. 1.

LEFT: TRISOMIC MUTANT PLANT; RIGHT: NORMAL JUTE PLANT.

In the course of cytogenetical studies a variant plant was discovered in the jute cultures which is characterized by much smaller and deeply serrated leaves. The plant proved to be highly sterile, setting a few seeds. Cytological studies have revealed 15 chromosomes in the root-tip cells as well as in the pollen mother cells. Selfed seeds collected from this mutant were grown this year. In Fig. 1 a typical mutant in the flowering stage is shown beside a

normal from the same pedigree culture. The differences are such that the mutants are easily recognizable. The trisomic is distinguished from the normal plant, from which it arose, not merely by single visible differences but also by a complex of characters which seem to be inherited as a whole in the offspring.

The leaf is the part of the plant which is most conspicuously affected, and I can pick out readily the trisomic mutant from the seed pan before the opening of the second leaves. The leaves are narrower, pointed and much more serrated than the normal. The two hood-like appendages generally present at the base of the lamina in all the normal varieties of jute are totally absent in the trisomic mutant. The petiole is on an average 2.1 cm. in length while those of the normal measure 3.3 cm., the lamina is 4.2 cm. \times 1.6 cm. in size, the normal being 6.2 cm. \times 3 cm. on an average. Axillary branches extrude from the axil of the leaves, causing irregular branching and increasing the strangeness of appearance of the trisomics. Flower buds are much smaller, stamens fewer in number, ranging from 10-16, whereas in normal plants the stamens are 15-24. Some of the stamens in the mutant are deformed and transformed into petals. Anthers are generally empty with aborted pollen grains; ovary with trifid or 4-fid stigmas, the normal being single and undivided; capsule smaller, seeds very few, with a low fertility.

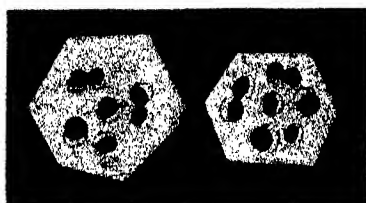


Fig. 2.
METAPHASE I FROM NORMAL (LEFT) AND TRISOMIC PLANTS (RIGHT), SHOWING PAIRS OF BIVALENTS SECONDARILY ATTACHED.

Study of the pollen mother cells at diakinesis revealed six pairs of bivalents and a trivalent frequently, as also seven pairs of bivalents and a univalent. At metaphase I, the trivalent divided as usual, two chromosomes passing to one pole and the third to the opposite pole. Sometimes a lagging univalent was noticed in the first and second division.

The trisomic mutant thus produces dimorphic gametes with 7 and 8 chromosomes. The breeding behaviour of the trisomic shows that when the mutant is selfed or crossed with normal pollen, it produces a large number of trisomic mutations in the offspring. But when the normal is used as female and trisomic as the male, the percentage of trisomic in F_1 is reduced to a considerable extent. This shows that egg cells with one extra chromosome are more effective in fertilization.

With regard to the origin of this trisomic mutation, it has been noticed that the normal sometimes throws trisomic plants under field conditions. Cytological studies of the normal plants with 14 chromosomes showed failure of pairing of one bivalent in some of the pollen mother cells. At metaphase I, eight chromosomes pass to one pole and six chromosomes to the other. It is possible that the same thing happens in the megaspore mother cell. The trisomic most probably arises from the mating of an egg cell

with 8 chromosomes to a normal 7-chromosome pollen grain.

It may also be mentioned here that the cultivated varieties of jute are usually regarded as diploids. But chromosome morphology and meiotic chromosome behaviour indicate that jute is a secondary polyploid. The metaphase I (Fig. 2) from normal and trisomic shows pairs of bivalents secondarily associated. The maximum association observed is two groups of two bivalents, the other three bivalents remaining separate. It is therefore suggested that the basic number of *C. capsularis* is $n = 5$, and that the present number $n = 7$ is secondarily balanced.

An analysis of the genetic constitution of different trisomic types obtained is proceeding, and the use of trisomic ratios in locating the genes affecting different characters is being studied.

H. K. NANDI.

Bose Research Institute,
Calcutta.
Sept. 27.

Wild Birds and Butterflies

PROF. G. D. HALE CARPENTER has recently published "Further Evidence that Birds do attack and eat Butterflies". I have read this paper with great interest, and while I am fully aware that the observations contained therein approach the subject from rather a new angle, they are, to me, quite unconvincing in so far as they claim more than that butterflies constitute but the merest fraction of a bird's food.

I am surprised that Prof. Carpenter is apparently unaware of the evidence I set forth in a letter in NATURE in 1929¹. The observations there were made by men with long experience, and specially trained observers of the stomach contents of wild birds. None of them was likely to overlook the scales of a butterfly's wing, the spicules of worms, the eggs of insects, or the limbs or cuticle of an isopod, and yet none of them found butterflies in an appreciable percentage in upwards of 100,000 stomach contents.

No one can deny that birds do snap at the wings of butterflies. Sir Guy Marshall has chronicled a long list of such cases². On rare occasions they may possibly eat the bodies, but these cases, in my opinion, are few and far between.

Many years ago I had planted in my garden a new variety of lettuce, and I was puzzled at finding the leaves cut in this fashion A. Careful observation soon proved that house sparrows, chaffinches, tits, robins and thrushes were the depredators, but it would be unscientific to chronicle these species of wild birds as enemies of lettuce, or to say that such food constituted anything but an infinitesimal fraction of their food.

WALTER E. COLLINGE.

Yorkshire Museum,
York.
Nov. 8.

¹ Proc. Zool. Soc. (Ser. A), 223-247 (1927).

² NATURE, 324, 335 (Aug. 31, 1929).

³ Trans. Entom. Soc. Lond., 329-333 (1909).

DR. W. E. COLLINGE is apparently under a misapprehension as to the degree to which it is claimed that birds eat butterflies. I do not think that it is ever claimed that these insects form the principal food of any bird; only that they are eaten to an extent sufficient to have a selective effect, and I

believe that work by Prof. R. A. Fisher has demonstrated mathematically that this extent need be very much less than was previously supposed.

Dr. Collinge's point of view on this question seems to be expressed by his phrase "No one can deny that birds do snap at the wings of butterflies". It is because the imprints known as beak-marks imply something more than merely snapping at wings that for some years attention has been particularly directed to this subject, presumably that which Dr. Collinge mentions as an approach from a new angle. The clear A-imprint on the scales means that the wing has been definitely held in the beak but that the butterfly has escaped again. The high proportion of species with 'distasteful' qualities among beak-marked specimens is at present engaging particular attention; it is a very significant fact.

The observation by Mr. T. H. E. Jackson recorded in *NATURE*¹ deals with selective feeding upon butterflies by a bird to a considerable extent. The black-and-white African wagtail (*Motacilla*) habitually feeds upon butterflies, as shown by observations by Pitman², who mentions it daily "consuming dozens of butterflies", Major I. G. Owen in the Sudan³, and Mr. J. P. Chapin⁴, as well as by myself in Uganda⁵.

An observation recently received from Mr. C. W. Chorley, an experienced field-naturalist in Uganda, may be quoted here: it is apt because attention

has been directed to the lack of evidence of attacks upon migrating butterflies. Mr. Chorley wrote: "Once in Ankole I saw a migration of thousands upon thousands of butterflies [apparently a species of *Glycestia* = *Belenois*] travelling towards the west. The Yellow-fronted Bush Shrike (*Chlorophoneus sulphureuspectus* Less.) was very numerous and at the foot of the perches there was quite a collection of butterflies' wings".

Finally, it is a little hard to be criticized for not mentioning a paper on *negative* evidence in a contribution entitled "Further evidence . . .". This was put together from notes hitherto unpublished to aid the provision of evidence which is said to be lacking. A discussion of the whole subject would have necessitated reference not only to the negative evidence but also to much recent positive evidence of which Dr. Collinge is apparently unaware, and would have been a larger undertaking than was attempted.

G. D. HALE CARPENTER.

University Museum,
Oxford.
Nov. 11.

¹ *NATURE*, 135, 194 (Feb. 2, 1935).

² Pitman, C. R. L., *J. Bomb. Nat. Hist. Soc.*, 33, 204 (1948).

³ Observation 22 of the paper under discussion.

⁴ Chapin, J. P., *Natural History*, 22, 66 (1922).

⁵ Carpenter, G. D. H., "Mimicry", p. 89. (Methuen and Co., Ltd., 1933).

Points from Foregoing Letters

Dr. W. T. Astbury summarizes accumulating X-ray evidence for the belief that ultimately there will be found no real distinction between 'fibrous' and 'globular' proteins, and points out that the stoichiometrical data of Bergmann and Niemann indicate the same thing. He shows how X-ray measurements can be used to supplement the Bergmann argument, and calculates a stoichiometrical distribution of amino acid residues and provisional molecular weight for keratin, which also appears to fit into the new scheme.

Dr. F. Levi describes some experiments which confirm certain consequences of C. V. Raman and N. S. Nagendra Nath's first simplified theory of the diffraction of light by ultrasonics at oblique incidence hitherto not experimentally verified.

From measurements of the magnetic susceptibility of nickel, of cobalt and of iron-vanadium alloys (from which the susceptibility of iron can be obtained by extrapolation), Prof. W. Sucksmith and R. R. Pearce calculate the magneton number of these metals. The susceptibility for cobalt was found to be linear between 1,280° and 1,450°, and that of nickel between 500° and 925°. Above 925°, for nickel, the slope of the $1/\chi, T$ curve decreases.

Dr. D. S. Kothari and B. N. Srivasava point out that the heat absorbed or given off when a gas such as helium expands in a vacuum (Joule-Thomson effect) can, under suitable conditions, provide an experimental test to show whether the statistics of Fermi-Dirac or Bose-Einstein are applicable under those conditions. The authors give formulae from which the magnitude of the effect may be calculated, both for 'degenerate' gases (which deviate from the

gas and Van der Waals' laws) and for non-degenerate gases.

A curve showing the absorption of visual purple pigment (of the frog *Rana esculenta*), in solution, is compared by Prof. R. Granit with the 'physiological' absorption. The latter is obtained by calculating the 'effective intensity' from the luminosity curve determined from the response to an electrical stimulus. There is a reasonably good fit of the two curves for the longer wave-length, but for the shorter wave-length the absorption of the visual purple is higher than the 'physiological' absorption.

A diet deficient in vitamin E is found by Dr. B. P. Wiesner and A. L. Bacharach to have a complex disorganizing effect upon the sex organs and sex behaviour of the male rat. The addition of vitamin E to the basal diet does not bring about complete normality and some other factor may therefore be involved.

A single large dose of vitamin D injected in the muscle is found by Dr. H. Rotter to protect rats living on a rachitogenic diet for a long period.

The character and behaviour of a variant of the common jute plant, containing 15 chromosomes in the nucleus instead of the usual 14, are described by Dr. H. K. Nandi. It produces sex cells (gametes) containing seven and eight chromosomes, and breeding experiments indicate that the egg cells with one extra chromosome are more effective in fertilization. The behaviour of the chromosomes during nuclear division, the author states, leads to view that the basic number of chromosomes in the jute is five and that the present usual number, seven, is secondarily balanced.

Research Items

Fatigue and Air Movement in Rooms

WHILST the importance of maintaining the air in a public building or in the home at a reasonable standard of purity has been appreciated for many years, it is only recently that the importance of keeping the air in movement has been seriously considered. This question is discussed in a paper by J. R. Henderson in the *G.E.O. Journal* of August. It has been noticed that when no movement of the air at head-level is provided, a feeling of 'stiffness' is experienced, accompanied by fatigue and loss of efficiency. The necessity for air movement is emphasized in the Home Office Welfare Pamphlet No. 5 (London: H.M. Stationery Office). It states that no work-room, even if lofty and spacious, is satisfactory without adequate air movement, and that the importance of this to physical health cannot be too widely understood. It is difficult to lay down definite rules concerning the optimum air velocity. It seems to lie between 50 feet and 200 feet per minute according to the prevailing temperature and humidity, and also to a certain extent to individual requirements. Some individuals, acclimatized to hot and humid conditions, are very susceptible to draughts. There are three principal methods of producing the necessary air movement: by high-velocity streams of air flowing through a system of ducts and fed by an air-conditioning plant; by table electric fans of the propeller type; and by ceiling fans. The high-velocity jets are usually part of an air-conditioning plant. For the home and small offices, the table or bracket fan is successfully used. If necessary, oscillating mechanisms are fixed to them to increase the area over which they are effective. Ceiling fans are the best means of producing air movement in large rooms. Owing to the large sweep of the slow-speed propeller, it is more silent than table fans. Their power consumption is small, being less than that taken by a hundred-watt lamp. When a regulator is used, a wide range of speeds is obtainable.

Digestion in Polyplacophoran Molluscs

A MORE complete account of the morphology, histology, mode of action of the alimentary canal and of the process of digestion in polyplacophoran molluscs than has hitherto appeared is now furnished by Vera Fretter (*Trans. Roy. Soc. Edin.*, May 1937). The principal type studied is *Lepidochiton cinereus*, but the following are also fully compared with it: *Acanthochiton crinitus*, *Ischnochiton magdalenensis* and *Cryptochiton stelleri*. The account is illustrated by plentiful, clear figures. The stomach in some species is complex and divided into a dorsal channel, with two longitudinal ciliated bands and a non-ciliated sac. The bilobed digestive gland has two ducts opening into the dorsal channel. It is only in this digestive gland that the soluble food material is absorbed. In *I. magdalenensis* and *C. stelleri* the intestine is complexly coiled. Food is conveyed through the oesophagus to the stomach by ciliary currents. The posterior oesophageal pouches secrete an enzyme with an optimum pH of 5.8 and an optimum temperature of 34° C. The stomach produces a proteolytic enzyme with an optimum pH

between 4.29 and 4.86. The intestine is divided into an anterior and a posterior moiety separated by a valve which regulates the passage of food through the gut and also shapes faecal pellets. The alimentary canal of the group resembles that of the lower gastropods in structure but differs in function.

Chironomid Fauna of River Mosses

AN interesting research has been carried on by Carmel F. Humphries and Winifred E. Frost during a biological survey of the River Liffey, the primary object of which was to investigate the food and growth of the brown trout (*Salmo trutta*) from acid and alkaline waters ("The Chironomid Fauna of the Submerged Mosses" River Liffey Survey. *Proc. Roy. Irish Acad.*, 43, Section B, No. 11, 1937). The paper deals with the chironomid larvæ and pupæ found in these mosses, and the results are striking. One alkaline and one acid site were chosen, and although the species of mosses were different, it was found that the fundamental form was the same, so that the chironomids had similar habitats, and the total estimated number of larvæ is almost the same in the two sites. The dry weight of moss formed the same proportion of the whole sample in both places. Percival and Whitehead (1929) stated that in the River Wharfe "By far the greater proportion of the Midge larvæ of our area consists of *Orthocladiaræ*". The present authors find that it is the same in the Liffey and that there is a close quantitative similarity between the chironomid fauna at the two stations, the dominant subfamily in both cases being the same, and forming an almost equal proportion of the organisms present. The *Orthocladiaræ* constitute 95.9 per cent of the total chironomid fauna at Straffan, the alkaline site, and 98.6 per cent at Ballynutton, the acid site; the remainder is composed of *Tanytarsaræ*, *Chironomariæ* and *Tanypodinæ*. The seasonal distribution of all the chironomid larvæ as expressed in the graph shows that the seasonal abundance of the larvæ from the acid and from the alkaline waters is almost identical.

Citrus Manuring

AN outstanding example of the application of modern statistical methods to the elucidation of interacting factors in the nutrition of fruit trees on a commercial scale is presented by F. G. Anderssen in a recent investigation on citrus manuring in South Africa (*J. Pom. and Hort. Sci.*, 15, 2, 117; 1937). The experiment was designed to determine the influence of the common artificial fertilizers on the composition and quality of oranges and on their keeping quality. 2,500 Washington Navel orange trees comprised the experimental material, and these were manured with twenty different combinations of potash sulphate, superphosphate and ammonium sulphate, with applications of lime and the sowing of cover crops on some of the plots. Records were taken of crop weights, tree growth, rind thickness and keeping quality of the fruit, and chemical analyses were carried out on the fruit juice, rind and pulp. The data when analysed statistically gave

definite evidence of the effects of the various treatments. Applications of ammonium sulphate to the soil induced very marked increases in weight of crop and number of fruits, but there were no significant differences between applications of 2, 4 and 6 lb. per tree. A leguminous cover crop did not increase the nitrogen content of the soil or the size of crop, nor was crop size affected by superphosphate, potassium sulphate or lime. Calculations of correlations and partial regression coefficients showed that a high phosphorus content and probably also a high calcium content in the fruit were associated with low acid content and thin rind. High potassium content, on the other hand, caused high acid and thick rind. High calcium content caused an increase in the amount of wastage in storage due to mould, whilst nitrogen had the reverse effect. Sugar content and total soluble solids were increased by high nitrogen content, which was also shown to be necessary for the synthesis of phosphatic organic substances. The juice content of the fruit was not directly affected by any of the factors determined. The importance of balanced nutrients is emphasized, particularly in respect to nitrate and phosphate, which should be present in high concentration and suitable proportions.

Bending Wood by Hand

At the Forest Products Research Laboratory of the Department of Scientific and Industrial Research an investigation has been made on the practice of bending solid wood by hand as distinct from machine bending, and the conclusions reached have now been published ("Methods of Bending Wood by Hand", *Forest Products Research Bull.*, No. 17. London: H.M. Stationery Office, 1937. 1s. net.) Of the bending machines available, there are few which are capable of producing a really large variety of designs, and, as a result, the most complicated bends are still almost invariably made by skilled hand-bending operators. The process is divisible into three distinct stages—the preparatory softening of the wood, the actual bending and the setting of the bend—and each of these is dealt with. In the first, steaming is regarded as the most efficient method, and the preparation and treatment of the blanks are discussed. Several different bending appliances are illustrated and described, including those for bending over pegs, and for bending between forms, the use of one form and a strap, and the need in certain cases for additional appliances such as clamps, end stops, wedges, etc., to prevent tension, shear or other failure of the wood. It is on the intelligent adoption of the right type of equipment that the combination of economy and success depends, and the text seeks to set out in general terms the principles by which one should be guided in these matters. Examples are given of difficult bends such as the Austrian chair-back type of bend, the S and sinuous types, and two-plane bends. The final setting stage has an important bearing on the finished bend; the conditions under which it must proceed are explained and particulars of the temperatures and precautions to be observed are set up. The Forest Products Research Laboratory invites inquiries from those who wish assistance in its subject, and places the results of its experience at the disposal of anyone interested. There is a wide field for quantitative investigation of this age-old process and the wood properties on which it is dependant.

Glaciers of the Wicklow Hills

IN an investigation of the glacial events in the Wicklow region during the later stages of the Glacial Period, Prof. J. K. Charlesworth has amplified the recent researches of Mr. A. Farrington on this subject. Prof. Charlesworth's recent paper (*Proc. Roy. Irish Acad.*, 44, B, No. 3) is entitled "A Map of the Glacier Lakes and Local Glaciers of the Wicklow Hills". A notable feature is the smallness of the glaciers on the western side compared with their development on the eastern side, but Prof. Charlesworth's most striking conclusion is that the whole upper surface of the mountain plateau, above about 2,000 ft., was covered by a firm field. In this conclusion, he differs from Mr. Farrington. Prof. Charlesworth shows how the Irish Sea ice-sheet, in pressing against the flanks of the Wicklow Hills, closed the valley mouths and ponded the water into lakes which were drained by overflow valleys excavated across the main watershed, or projecting spurs. The withdrawal of the ice towards the north resulted in the more southern overflow valleys being smaller than the more northern.

Earthquake Swarm of Itô in Japan

THE remarkable swarm of slight earthquakes felt at Itô during the first half of 1930 has already been referred to in these pages (126, 326, 971). Mr. F. Kishinouye has recently studied their variations in frequency (*Bull. Earthq. Res. Inst.*, 15, 785-826; 1937), and, if he had done nothing more than print, for the first time in English, a complete list of all the shocks recorded at Misako, his memoir would have possessed great value. From February 14 until June 26, the total number was 5735. A peculiarity of swarm earthquakes is that large numbers are crowded into a few hours of the day. On March 8, for example, the numbers in four successive hours were 54, 35, 19 and 29, while, during the rest of the day, there were only 24, and in each of 13 hours no shocks were felt. Such concentration, of course, limits the determination of seismic periods, and it is not surprising that the existence of a diurnal period is regarded by the author as doubtful. The diagrams representing the height of the tide and the hourly numbers of earthquakes recorded at Misako seem to show that earthquakes are most frequent at the times of low water, but Mr. Kishinouye does not admit any connexion between them owing to the small amplitude of the semi-lunar period. An interesting result follows from the comparison of the diagrams of the frequency and seismic energy of the Itô earthquakes, namely, that the strong earthquakes occurred as a rule during intervals of great frequency.

Vitamin C in the Potato

BEFORE the potato was introduced into the Netherlands, scurvy was a very common ailment; to-day the potato is the chief source of vitamin C in the dietary of the Dutch people. In the few determinations of the vitamin C content of potatoes that have been published, no regard has been paid to the possible differences between varieties or to the possible influence of the conditions under which they are grown. These points have recently been investigated by J. B. H. Ijdo, of the Hygiene Laboratory of the University of Utrecht, and his results are recorded in the *Landbouwkundige Tijdschrift* of August-September 1937. He has found that the vitamin C

content of thirteen varieties of potato grown in the same conditions varied from 25 to 63 per cent, whereas samples of the same variety showed an average difference of only 10 per cent. Locality of growth was also found to influence the content of vitamin C in potatoes of the same variety; the greatest difference observed was 40 per cent for the variety 'Iris'. Practically no difference was found between the contents of small and large tubers, or between samples taken from the centre and the periphery of the same potato. The absolute amount of vitamin C was found to vary from about 10 mgm. to 20 mgm. per 100 gm. of fresh material, a result which is in keeping with those previously published by other investigators.

Atomic Distances in Crystals

THE empirical function used by Pauling, Brockway and Beach to relate interatomic distances to bond types has been used to predict the carbon-oxygen and nitrogen-oxygen distances. A large discrepancy occurs for the carbonate ion between the predicted distance of 1.32 Å. and the distance reported for calcite. N. Elliott (*J. Amer. Chem. Soc.*, **59**, 1380; 1937) has now redetermined the C-O distance in calcite and the N-O distance in sodium nitrate by X-ray methods by Laue photographs. The parameters found are 0.2635 for calcite and 0.2394 for sodium nitrate. These lead to the values for the interatomic distances of C-O = 1.313 Å. and N-O = 1.210 Å. A comparison with the distances predicted by Pauling, Brockway and Beach is made, and agreement is found for the carbonate ion. In the case of the nitrate ion, however, the predicted value is 1.26, leaving a discrepancy of 0.05 Å. It is suggested that this is due to a previously unrecognized factor, the effect of the resultant charge of an atom on its covalent radius. In the nitrate ion there is a double bond to a neutral oxygen atom and single bonds connecting nitrogen with a formal charge +1 with oxygens with formal charge -1. Resonance between the double bond and the single bonds would be expected to diminish the N-O distance by 0.05 Å., so explaining the discrepancy. The phenomenon should be observed in other substances such as the tetramethylammonium ion, and experiments to test this prediction are planned.

Petroleum Fuels in Canada

LAST year the Canadian Department of Mines issued a Bulletin (No. 772) giving statistics of petroleum fuels marketed in Canada during the years 1933 and 1934. A further Bulletin (No. 780) is now available, which deals with comparable statistics for the year 1935. As in earlier years, petroleum fuels are divided into four main classes, namely, fuel oil, kerosene, gasoline and petroleum coke. First, tables are given showing quantities of each type marketed in Canada during 1935 and their distribution throughout the various Provinces, and then each class is considered separately. In this year, more than 85 per cent of fuel oil was processed in Canadian refineries, the rest being imported. Of this, more than 24 per cent of the total was used for domestic heating, 26 per cent for industrial heating and power, 7 per cent for tractor fuel and 41 per cent for fuel for rail and water transportations. Deliveries of kerosene in 1935 represented less than one fourteenth of the volume of fuel oil, or about one thirty-third of the

total volume of petroleum fuels delivered. In fact, about 1 million gallons less kerosene were delivered in this year than in 1934. 65 per cent of the total sold was used for domestic heating, cooking and lighting, 23 per cent for tractor fuel and the rest for general miscellaneous uses. Gasoline statistics given in the report are not strictly comparable with those furnished for fuel oil and kerosene, as they merely represent the amounts recorded by the several provincial tax departments of the Bureau. Nevertheless, a general study of these tables shows that the provisional figure for total sales during 1935 exceeds that for 1934 by nearly 39 millions of imperial gallons.

Magnesium Alloys

THE low density—1.74—of magnesium has led in recent years to its introduction into industry for the production of light articles not subjected to excessive stresses in use, and a considerable amount of information is now available as to the strength of the material and of many of its alloys. The issue of the *Science Reports* of the University of Sendai, Japan, for September, contains a report by Messrs. H. Endô and S. Morioka to the Research Institute for Iron, Steel and other Metals on the corrosion of magnesium alloys containing manganese and silicon. The corrosion is measured by the decrease in weight of rods of the alloys 3 cm. long and 0.5 cm. diameter immersed in 0.1 normal solutions of common salt in water for periods of 5–30 days. The authors conclude that the following are the compositions of the alloys which show the greatest resistance to corrosion under the above conditions: For magnesium-manganese alloys cast, Mn exceeding 2 per cent; annealed at 470° C., Mn exceeding 0.6 per cent; for Mg-Zn-Mn alloys, Zn 2–6 per cent, Mn 0.6–2 per cent; for Mg-Sn-Mn alloys, Sn 2–8 per cent, Mn 0.5–2 per cent; for Mg-Zn-Si alloys, Zn 2–6 per cent, Si 0.05–0.8 per cent; for Mg-Zn-Al-Mn alloys, Zn 4, Al 6, Mn exceeding 1 per cent. They attribute the resistance to the formation of a film of $\text{Mn}(\text{OH})_2$ or $\text{MnO}_2 \cdot 2\text{H}_2\text{O}$, mixed with $\text{Mg}(\text{OH})_2$ on the surface.

Oriented Crystallization

THE July issue of the *Memoirs of the College of Science* of the University of Kyoto contains descriptions of two methods of obtaining crystals with a particular axis oriented in a given direction. The first, due to N. Matsumoto, consists in forming the crystals between the fibres of a bundle of stretched rayon threads by dipping the bundle into a saturated solution of the substance and then allowing the solvent to evaporate in the air. On examining the bundle under X-rays, he finds that the patterns due to the crystals can be distinguished from those due to the bundle of threads and that they indicate that one crystalline axis is parallel to the fibres. In the case of ortho-rhombic potassium chromate, for example, it is the *a* axis of 5.88×10^{-8} cm., and in that of monoclinic sodium sulphate the *c* axis of 11.5×10^{-8} cm. The second method, by S. Shimadzu, consists in allowing a metal plate to stand for a couple of days in a weak solvent, for example, silver in chlorine water. On examining the surface of the plate by electron diffraction, it is found that the (331) axes of the cubic micro crystals of the silver chloride are all arranged perpendicular to the surface of the plate.

Anniversary Meeting of the Royal Society

THE presidential address to the Royal Society was delivered by Sir William Bragg on November 30, opening with the usual brief references to the work of fellows of the Society who died during the past year. Their number this year is unusually high, namely, twenty-four fellows and two foreign members. A portion of Sir William's address is printed elsewhere in this issue (p. 954).

The report of the Council refers to a number of matters of interest, including the various activities of the Society during the 275th year of the Society's existence. On the accession of King George VI the Society was informed that His Majesty was graciously pleased to follow the practice of his predecessors in becoming the Patron of the Society.

His Majesty has also graciously signified his intention to continue the gift of the two Royal Medals which have been awarded annually by the Sovereign since their institution in 1825 by King George IV.

The proposal of the Council that the number of candidates selected for election annually shall be twenty instead of seventeen has been finally approved and the first election of twenty fellows will take place in March 1938.

The total expenditure authorized by the Council for the promotion of scientific research during the year under review was £33,500 and in addition nearly £10,000 was spent in the production of the Society's scientific publications. In these figures are included the Government grants in aid of scientific investigations and publications. The nature and scope of the research work undertaken by the research professors, fellows and students appointed by the Society and by other recipients of grants are indicated in a series of reports printed in the report; and they demonstrate to what good purpose the grants are being put.

When the Bermuda Oceanographic Committee held its first meeting in 1936, Dr. H. B. Bigelow, director of the Woods Hole Oceanographical Institution, proposed that an intensive programme of research into Gulf Stream and Atlantic Drift problems should be carried out jointly by the Woods Hole Oceanographical Institution and the Bermuda Biological Station. The proposals were strongly supported by the trustees of the Bermuda Station, who were, however, unable to undertake their share of the scheme without further financial assistance. Since fluctuations in the strength of the Atlantic Drift are suspected to have a marked effect on the sea fisheries of the United Kingdom, it was hoped that support for the proposed work might be obtained in Great Britain. The Committee recommended that the Council of the Society should make application through the Development Commissioners for a grant to cover the cost of the work. The Council agreed to these proposals; and, subject to certain conditions, a grant of £5,100 for capital expenditure and £3,500 a year for a period of five years has now been allocated for an approved programme of research. The scheme which has been approved includes provision for the employment of two scientific officers, who will assist Dr. J. F. G. Wheeler, director of the Bermuda Biological Station, and for an annual subvention to the station, which will be used as the base for the oceanographical work. The Committee is also providing a small research vessel to make the necessary

observations at sea, and the selection and equipment of this vessel have been entrusted to a Ship Sub-Committee with Vice-Admiral Sir Percy Douglas as chairman. Unless unforeseen difficulties occur, it is expected that the research boat will be at work in the spring of 1938. The two additional members of the scientific staff have been appointed and will leave shortly for Bermuda. Dr. Ernest F. Thompson has been selected for the post of hydrologist and Dr. Hilary B. Moore for that of assistant to the director.

The Pilgrim Trust has offered to the Society 250 guineas annually for six years to allow an annual "Pilgrim Trust Lecture" to be arranged jointly by the Royal Society and the National Academy of Sciences and to be given alternately in London and Washington. The National Academy has agreed to co-operate. It is hoped that the first "Pilgrim Trust Lecture" will be given by an American scientist before the Royal Society in the summer of 1938.

PRESENTATION OF MEDALS

Copley Medal: Sir Henry Dale, C.B.E., F.R.S.

Sir Henry Dale's most important contributions to physiology and pharmacology lie in two different but closely related fields: (1) the isolation of certain chemical substances, notably histamine and acetylcholine, from animal tissues, and (2) the discovery of the part played by these in a large number of important physiological and pathological processes.

Dale's earlier work (1905-11) on the active principles of ergot led to progress in many allied subjects. The study of histamine, isolated from ergot extract and later found as a normal constituent of certain tissues, has modified profoundly our views of the capillary circulation and of the conditions known as 'wound shock' and 'anaphylactic shock'. In 1914, he became interested in the choline esters, and with extraordinary prescience singled out acetylcholine as the most interesting member of the series and pointed out the extreme likeness of its action to that of stimulating the parasympathetic.

In 1924, Loewi demonstrated that a substance indistinguishable from acetylcholine is liberated by the heart when the vagus nerve is stimulated. The researches of others, prominently among them Dale himself and his colleagues, have since shown that acetylcholine is liberated at many other junctions between conducting tissues, and the results with acetylcholine and adrenaline are embodied in the description of nerves as 'adrenergic' and 'cholinergic'. Recently convincing evidence has been given by Dale and his collaborators that acetylcholine plays an important, possibly an essential, part in the transmission of impulse from nerve to voluntary muscle: a discovery which has direct practical bearings on muscular fatigue and in various pathological conditions, and also is of the greatest interest in the theory of the mechanism of the nervous and neuromuscular systems.

As director of the National Institute for Medical Research, Dale has inspired and directed a wide variety of investigations outside his special field, and numerous investigators from many countries have worked under his guidance.

A Royal Medal: Prof. N. V. Sidgwick, O.B.E., F.R.S.

Prof. Nevil Vincent Sidgwick has always been primarily interested in the causes which determine molecular structure, and his earlier experimental work chiefly dealt with such subjects as tautomerism, and the vapour pressures, boiling-points and solubilities of isomerides. The development of the conception of the nuclear atom made possible for the first time a quantitative treatment of chemical valency other than purely formal, and the first steps in this direction were taken by Langmuir, G. N. Lewis and Kossel during, or just after, the Great War. Others followed with theoretical or physical extensions.

Sidgwick's post-War experimental work has all been concerned with particular problems of structure, utilizing to the full available physical methods of attack. To take a few examples, he has shown the existence of co-ordination compounds of the alkali metals, and has demonstrated the co-ordinating properties of the hydrogen atom. In particular, it was he who distinguished clearly the existence of a third and very important type of chemical binding, the so-called co-ordinated covalent link.

In 1927, Sidgwick published "The Electronic Theory of Valency", in which, for the first time, the most diverse structural phenomena covering the whole field of chemistry were rationally systematized. The book met with immediate and enthusiastic acceptance. In 1928, he played a leading part at a conference held at Munich to discuss chemical binding in its relation to atomic structure. In 1931, he lectured in the United States of America. He has continued his work of fruitful interpretation in a series of remarkable contributions made to the annual reports of the Chemical Society, and in his recent presidential addresses to the same Society on the subject of resonance phenomena in chemistry.

A Royal Medal: Prof. A. H. R. Buller, F.R.S.

Dr. Arthur Henry Reginald Buller was professor of botany in the University of Manitoba in 1904-36. His original contributions to science are mainly in the field of mycology and have been published in his "Researches on Fungi", six volumes of which have appeared.

These researches fall into two groups. The first comprises studies on the morphology, biophysics and physiology of the higher fungi, including the physiology of the mycelium and the organs produced on it, and especially of the production and liberation of spores. The second group deals with sex in the higher fungi, and Buller's studies on this subject rank among the most important that have been made. Particular mention should be made of his observations on the process of diploidization in the higher fungi, and of the discovery of heterothallism in the rusts in conjunction with his student Craigie, work which has revolutionized our conception of the life-cycle of these forms. Buller's studies have not been confined to one group of fungi, but include researches on Discomycetes and many groups of the Eu-Basidiomycetes, as well as on rusts and smuts. Reference should also be made to his "Essays on Wheat" and also to his efforts which made possible the publication of the translation by his friend W. B. Grove of the brothers Tulane's monumental "Selecta Carpologia Fungorum".

Davy Medal: Prof. Hans Fischer

During the past twenty-five years Prof. Hans Fischer has been continuously engaged in the study of the chemistry of the porphyrins, the bile pigments and chlorophyll. Starting from the knowledge that the porphyrin molecule was built up of pyrrole nuclei, variously substituted in the different porphyrins, Fischer developed controlled methods of degradation which extended the possibility of the identification of the pyrroles in any given porphyrin.

With the accurate information acquired in this manner as a basis, Fischer proceeded, by bold and original synthetic work, artificially to prepare a large number of porphyrins of known structure, many of which proved to be closely related to or identical with natural products; his crowning achievement in this field was the synthesis of protoporphyrin, which, with iron, yielded hæmatin identical with that derivable from blood hæmoglobin.

From the porphyrins Fischer turned his attention to the bile pigments and was able to explain the fundamental chemical features of their relationship to hæmoglobin, thus paving the way for the biochemical work which is now proceeding in other laboratories and which promises to explain the actual mechanism of bile pigment formation in the body.

In recent years Fischer has applied his brilliant synthetic technique with outstanding success to the elucidation of the detailed structure of chlorophyll.

Buchanan Medal: General F. F. Russell

Frederick Fuller Russell graduated from Columbia College of Physicians and Surgeons in 1893, and began his career as a member of the Medical Corps, U.S. Army, in 1898, advancing through the various grades to that of colonel in 1917. He resigned in 1920. He was curator of the Army Medical Museum, Washington, D.C., from 1907 until 1913, and also instructor in bacteriology and clinical microscopy at the Army Medical School, where he performed distinguished service in developing and producing the typhoid vaccine which the Army has used with great effectiveness since that time. From 1920 to 1923 he was director of the public health laboratory service of the International Health Board and from 1923 to September 1, 1935, he was general director of the Board. It was during the period while General Russell was director of the International Health Division of the Rockefeller Foundation that the Foundation gave such material aid towards the establishment of schools of hygiene in various European countries. It also contributed largely to the All India Institute of Hygiene in Calcutta and to the Singapore Medical School. General Russell was also responsible for establishing the yellow fever unit in West Africa. Large grants were given to the Health Section of the League of Nations, and the fellowship scheme under the International Health Division was considerably extended.

Sylvester Medal: Prof. A. E. H. Love, F.R.S.

Prof. Augustus Edward Hough Love is most generally known as the author of the "Treatise on the Mathematical Theory of Elasticity" which has attained a universal reputation and remains the standard work of reference on this subject all over the world.

Before the first edition of Love's treatise was published in 1893, this branch of mathematical physics

received little attention and its results were often regarded by engineers with suspicion. During the intervening years it has gradually established itself as one of the most reliable mathematical theories of continuous media and, unlike its sister science of non-viscous hydrodynamics, its results have been increasingly verified in practice. That this has come about is due in great part to the influence of Love's "Treatise", which, indeed, like Lamb's "Hydro-dynamics", is far more than a mere treatise and embodies a vast amount of original work.

Looking at Love's other work there is a great volume of research dealing not only with elasticity, but also with hydrodynamics and electromagnetism. His earlier work was mostly on hydrodynamics, particularly vortex motion and wave-motion. He returned also at various times to electrical problems, especially those relating to the propagation, scattering and transmission of electric waves. His elastical investigations range over an exceedingly wide field, from the equilibrium of beams and plates of various shapes to the study of vibrations in a variety of difficult cases and to the applications of the theory of elasticity to problems connected with the earth.

Hughes Medal: Prof. E. O. Lawrence

Prof. Ernest O. Lawrence, professor of physics in the University of California, is the inventor (1932) of the cyclotron, the most important instrument of physical research since the C. T. R. Wilson expansion chamber, whereby ions are accelerated in a magnetic field and move within two half-cylinders which change electrical polarity in rhythm with the circulating ions, so that deuterons have been spirally speeded in a vacuum to velocities due to three million volts, and these deuterons, impinging on beryllium, have produced neutrons and protons in great number, and some of the protons have been projected through the equivalent of forty centimetres of air. Many elements have been proved to be radioactive when thus bombarded by high-speed protons or deuterons.

Hydrogen molecular ions have been used also as bombarding elements with velocities due to five million volts. Such high-speed ions are available for developing the theory and practice of atomic disintegration, and Prof. Lawrence and his co-workers are playing a leading part in this development.

Racial Evolution and Archæology*

IN Huxley's day the Neanderthal calvaria was the only hominid not clearly included in the *Homo sapiens* group available for study; but since his time other skulls have been found, which make it evident that there were several hominids widely scattered over at least the northern hemisphere of the Old World, while the Broken Hill skull from Rhodesia may be taken as evidence of the penetration of one of these types into Africa south of the equator. There is thus conspicuous evidence already for an early stage of evolution of the unique capacity for migration that man has demonstrated.

W. D. Matthew suggested the plateau of Central Asia as the original home of man; but, on the whole, this is to be set aside, in part at any rate, for several reasons. It may well apply to the early beginning of hominid forms; but North Africa and south-west Asia, as Darwin suggested long ago, seem to have played the great part in the early evolution of the modern races. Here, broadly speaking, we have indications of important contributions to the full evolution of man as working themselves out to make our race increasingly different from the apes of the forests and their edges, taking to a life away from the vicinity of the trees and evolving towards the erect posture, with more effective stereoscopic vision, adding to this the use of tools held in the hand, increased attention to hunting, and consequent differentiation of the work of the two sexes. While this sketch is still partly unverified, circumstantial evidence, including physiological indications that man's constitution adapts him to a temperate environment, makes this the most probable hypothesis to use and test as new knowledge grows.

We need not assume that all the stocks of modern man descend ultimately from one pair of beings, or

even one small localized group. Nor should we assume that stocks of modern man in different parts of the earth have descended entirely from diverse ancestral hominids. We have to bear in mind the great migrations or drifts of humanity that have occurred from very early times onwards. It is the best hypothesis for the present to think of human stocks as of complex origin, with diverse constituents that may persist side by side to tell us of ancient drifts, as well as, perhaps, of diversities correlated with the different hominids concerned. Moreover, in every case we have to bear in mind the strong likelihood of adaptations to environment that may show themselves throughout a population, or may develop to different extents among its diverse constituents.

There is general agreement that the erect posture, improved stereoscopic vision and hunting developed among beings who lived a group life. All the indications we have for the past back to the Aurignacian-Capsian phases, even some relating to the Chelleo-Acheulean, suggest group life. Students of society have been apt to think of man as the creator of society. Ethical ideas have, in rather a perverse way, been set over against the natural tendencies. Yet it is an idea that is in large part false, if society is, as the scientific study of man suggests, a basic feature probably older than man. Self-conscious individuality is really a development within the matrix of society. Both grew side by side, with mutual adjustment, often after conflict, but with many movements towards considerable freedom of conscience, which may be considered the fine flower of the human social garden.

One cannot leave this aspect of the subject without reference to the importance of the woman's part from the earliest stages in the processes of both individualization and social evolution. Apart from maternal care, the development of the 'mother-tongue'

* Substance of the Huxley Memorial Lecture, 1937, delivered by Prof. H. J. Fleure before the Royal Anthropological Institute on November 9.

and other activities, cultivation grew from the food-collecting, rather than the hunting, function, that is, from the woman's side rather than the man's.

Prof. Fleure then proceeded to trace the evolutionary sequence in the development of the races of 'modern man', as classified according to physical character, and followed the probable course of migration of each in geographical distribution, correlating them with the development of phases of cultural life—hunting, agriculture, pastoral, and so forth—from the later palaeolithic period onward. His conclusion on the question of the racial composition of the people of any one specific area is that "As something special in the way of immigration, conquest or other change has affected almost every region, each must be considered for its own sake and on the basis of its own story, if we are to understand the composition of its population". He went on to consider the complex racial composition of the European populations, pointing to the possibility, still not proved, of the association of a peculiar and characteristic mentality with racial type. It has not yet been possible satisfactorily to discriminate verifiable bundles including both physical and psychical characteristics that tend to be handed down together in the course of inheritance. Achievements of different peoples in literature, religion, government and so on may be brought into relation with what are thought to be prevalent types, but these are the achievements of exceptional people, while the opportunities and difficulties presented by different environmental or historical circumstances affect the result.

The warped interpretation of archaeological data in support of the 'autarkic' idea, with the object of glorifying the Nordic race, was shown not to be in accordance with the facts. Prejudice claims that the Nordic race developed many of the chief features of

European civilization of itself and spread them to more southern lands. So far is this from being true, that it can be shown that in the development of culture in the Baltic we are dealing, not with the advantages of racial purity and seclusion from contamination, but with repeated fertilizations of the north by ideas and techniques from the more advanced south.

In conclusion, Prof. Fleure stressed as an inference from the evidence of racial evolution and archaeology the importance of a diversity of racial and cultural elements in a given population, as having tended to promote adjustments as between social groups and the recognition of justice rather than privilege and group ritual. The extrusion or suppression of active thinkers means the loss of the means of keeping in contact with the ceaseless process of change. "Any group," he said, "that claims for itself complete truth or knowledge really forfeits its status and title as a contributor to civilization, which is, in a very deep sense, the process of growth of freedom of conscience . . . The principle of freedom of conscience is claimed to be a large element in the scientific ideal, and a necessary part of it. Without it there can be little trust, even in alleged statements of fact, much less in the good faith of arguments. . . . Formerly it was widely held that basic general truths were known, and must be accepted and applied as guides of conduct. The scientific movement, on the other hand, has pressed the view that man's codes and creeds and conclusions are all provisional, that the truth is an ideal towards which we try to approach, but which we may never completely grasp. Freedom alone can, in the long run, keep us flexible enough for continuous adjustment to the ceaseless change that is the inevitable accompaniment of life."

The New Inventions Exhibition

THE Institute of Patentees' policy of going on tour has provided some interesting exhibits at the New Inventions Exhibitions at Sheffield (October 20-30) and Leeds (November 10-20) this year.

The exhibits varied from obvious, though ingenious, gadgets to complex mechanisms of scientific and social significance which require demonstrating to be 'understood of the people'. The total number of exhibits was about 260, of which forty are by Leeds, and fifty by Sheffield inventors, and the remainder international. Doubtless these numbers would be greatly increased if, quite absurdly, inventors had not to be 'uncertainty-bearers'—a true function of Capital—as well as advance creators—an all-but-unbearable burden.

There are several new engines. One of these purports to drive a dynamo direct by a piston, itself steam-driven. The steam is produced suddenly by successive drops of water reaching a coil heated by the dynamo, 'cranked' over to provide starting heat. Another exhibit is a turbine engine claiming to yield around 40 b.h.p., and has its rotor driven by petrol-air explosion impulses, the gas mixture being induced by an automatic compression unit revolving together with a driving shaft at 2,000 r.p.m., whilst the rotor revolves at 30,000 r.p.m. on the same shaft, reduction

gearing of 15:1 being required. Third, a two-stroke 'six' engine, which lends itself to mass production, has correct balance due to each power piston being balanced by a full-charging pump piston moving oppositely, and achieves noiselessness because of this and the absence of valves, tappets and gearing. There are but twenty-seven moving parts, and each crankshaft revolution has six power impulses giving even torque similar to an ordinary 12-cylinder engine.

The electrotor dust and smoke meter, already referred to in NATURE (140, 331, Aug. 21; 582, Oct. 2) abstracts the particles, however small, from dust or smoke suspensions over a wide range of application. Since dispersions actually consist of separate particles invisible to the eye, these must be microscopically counted to determine the dispersion. By providing an extensive choice of record areas in this light and convenient instrument, and achieving electrification, rotation, suction and centrifuging by one simple motivation, the countability of particles is maintained over a unique range of over 1,500,000 per c.c.

Pit-cage arresters; a trolley device making only one overhead wire necessary; and a bell rung inside when it rains, are other intriguing exhibits.

S. C. BLACKTIN.

Committee on Social Contacts of Science

THE Committee on Science and its Social Relations (abbreviation: C.S.S.R.), instituted by the International Council of Scientific Unions (I.C.S.U.) at its meeting in April last, and appointed in July (see NATURE, 139, 870, May 22, 1937; and 140, 358, August 28, 1937, for the members nominated), has recently met in London. It has elected the following officers: *President*: Prof. F. J. M. Stratton (Cambridge); *Vice-President*: Prof. S. Chapman (London); *Secretary*: Prof. J. M. Burgers (Delft). As a development of the original terms of reference, the Committee has adopted the following more precise statement of the objects of its activity: "to consider the progress, interconnections and new directions of advance in the mechanical, physical, chemical and biological sciences, especially in order to survey, at suitable intervals, and to promote, thought upon the development of the scientific world picture, and upon the social significance of the applications of science" (the corresponding French version reads: "pour examiner les progrès, les rapports réciproques et les orientations nouvelles dans les sciences mécaniques, physiques, chimiques et biologiques, spécialement afin de résumer, à des intervalles convenables, et de contribuer à l'étude du développement de la représentation du monde par la science et de l'importance sociale des applications de la science").

The Committee will begin its work by collecting materials for the preparation of a report and of bibliographies concerning the points mentioned, in so far as they are reflected in publications and state-

ments of the years 1936-38, and in books which have appeared since the post-War period. As a general plan for the report a division has been suggested into the following headings: (1) outstanding developments and problems in scientific work; (2) new applications of science in human society; (3) interpretative work on the world picture as given by science; (4) thoughts on the social relations of science and the influences connected with its applications.

To obtain the necessary information, the Committee in the first place will address itself to the national and international bodies adhering to the International Council (national academies, research councils, etc., and international scientific unions), which are being asked each to appoint a correspondent interested in the activities of the Committee, who will act as a link between the organization by which he is nominated and the Committee. Further, an attempt will be made similarly to approach a number of organizations, both national and international, outside the I.C.S.U.; this in consultation with the Institut International de Coopération Intellectuelle of the League of Nations.

The Committee will appreciate it if persons or institutions who are interested in the work undertaken, and are in a position to make suggestions or to give indications concerning phenomena or points of importance, would write to the Committee. Communications can be sent to any of the members, and in particular to the secretary (address: van Houtenstraat 1, Delft, Holland).

Progress in Road Research*

IN the Second Annual Report of the Road Research Board it is shown that many road failures have been caused by the imposition on existing roads of loads much greater than they were originally constructed to carry, with the result that the foundations have given way. This is not surprising when it is recalled that many such roads started as cart tracks, and in the course of their evolution were next converted to water-bound macadam and later given superficial dressings of tar or bitumen or coverings of tar macadam or concrete, the foundations receiving no reinforcement to render them more fit to bear the heavier loads which these improved surfaces were attracting to the roads. The foundation of the road is therefore a vital factor in its durability, and is itself dependent on the supporting qualities of the subsoil, so that both for the building of a new road and for the adequate treatment of an existing road an examination of the subsoil is an obvious prerequisite. The report describes a field procedure whereby cylindrical cores of undisturbed material

can be obtained from any site for the purpose of ascertaining its value.

The foundation usually consists of stones laid on the subsoil or, alternatively, concrete slabs may be used. The Road Research Station at Harmondsworth, West Drayton, Middlesex, has devised practical methods for the study and measurement of road aggregates and, while not yet in a position to place limits upon the maximum percentage of flaky or long material permissible in the bulk—a matter which at present is left to the judgment of the engineer—has adopted methods by which supplies of road aggregates can be compared with approved samples. No quantitative basis of the exact measurement of the roundness or otherwise of stone has as yet emerged and the terms employed are restricted to such descriptive words as round, sub-round, sub-angular and angular.

In connexion with the use of concrete in road work, the large quantities of material on the site, the time required to complete the work, and the variability of the British climate, combine to make conditions which defy uniformity in the product unless the means of rigid control can be provided. In the vibrator, a machine has been devised which

* Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the year ended 31st March 1936. Pp. viii + 136 + 9 plates. (London: H.M. Stationery Office, 1937. 2s. 6d. net.)

meets this difficulty and ensures that the sand and stone are brought to a constant water content before mixing. Bituminous road materials have also been under continuous review. These deform permanently under load to an extent depending on the time of application of the load, and the tendency to deformation under given conditions of loading can be adjusted by varying the viscosity of the binder and the grading of the aggregate. In some cases, cracks formed at low temperatures heal themselves in warm weather, and the application of heat to the binder may alter its characteristics. The effect of moisture reaching an aggregate before it is completely coated with binder is to promote disintegration. Thus load, time, temperature, rain and other weather conditions and their influences on bituminous constructions are being closely studied.

The length of life of bituminous roadways has been under investigation in full-scale experimental sections of roads, but the information available from these only comes in slowly and with difficulty, and the laboratory research which is in progress to overcome this delay ultimately must of necessity be slow until the results can be co-related with the full-scale tests. Three machines are in use at Harmondsworth to obtain the nearest approximation to continuous road conditions on limited areas. One of these presents the novel feature that the 5 ft. 6 in. diameter track under test is revolved under a wheel with stationary axis, which is fitted with a full-size pneumatic tyre. Its purpose is, in conjunction with laboratory tests, to eliminate undesirable factors in road construction and in surface dressings. Those which give favourable results under this wheel are tested again under the second machine, which operates with full-sized tyres under their rated loads and makes use of a track 38 ft. in diameter laid under ordinary conditions. Those materials which pass this second test are laid down to form a track of 110 ft. mean diameter and tested by a third machine by means of which a full-size lorry is run at maximum speed.

For the study of skidding, the standard machine consisting of a motor cycle and sidecar fitted with dynamometers as previously described is still used. The report points out that the limitations of this apparatus are its one size of tyre and load, both smaller than those of cars and commercial vehicles, the necessity for using smooth treads in order to obtain comparative results, and the fact that the machine records only side-way skidding. To meet these defects, another apparatus has been designed which will be towed by a two-ton lorry and will allow tests to be made with tyres of 27 in. diameter loaded up to 600 lb. A further apparatus has been designed and constructed at the Laboratory to make accurate measurements of surface irregularities, by giving a profile of the road surface.

It will thus be apparent that road research has now reached the stage of the active production of apparatus to measure the factors which are of importance in road construction. Although in recent years, as Dr. R. E. Stradling, the director of research, states in his survey, there has been a rapid advance in the methods of highway engineering, the absence of sufficient scientific knowledge has led to a certain amount of design and construction on the wasteful expedient of hit and miss procedure. The work of the Road Research Board very largely aims at the formulation of a science of road engineering, which will enable engineers to work on definite lines rather than by trial and error.

Science News a Century Ago

The Management of Bees

At a meeting of the Ashmolean Society, Oxford, held on December 4, 1837, Mr. W. C. Cotton, of Christ Church, read a paper on the management of bees, showing the defective system pursued by cottagers and suggesting improvements. All that was required for bee-keeping, he said, is a small garden or even a few yards of ground before the door of a cottage.

The great secret of success, Mr. Cotton observed, is never to kill a bee. The smoke of the large fungus or puff ball, when quite dry, had an intoxicating effect upon bees, and by its aid, weak swarms might be united to strong swarms, and the combs might be taken out of a full hive without injury to the bees themselves. The method of uniting swarms at the conclusion of the honey season was first practised by Mr. Thorley a century previous, and side boxes had been introduced about the same time by Mr. White. Bees were of the greatest use in distributing the farina of fruits and flowers. Bees seldom lived beyond the year so that no apprehension need be entertained that they would grow old and lazy. Mr. Cotton had just published a pamphlet on bee keeping for cottagers (*Athenæum*).

Mails from India

In the "Annual Register" for 1837 under the date December 8, it was said, "The project of steam communication with India through the Red Sea has been successfully accomplished, and is now in operation. The last communication was effected in forty-three days, including the stoppage at Alexandria. The following are the particulars: The *Atlanta* left Bombay on the 2nd of October and arrived at Suez on the 16th of October, with the mail of September; and at Alexandria on the 20th of October, from whence the mail was despatched by her Majesty's ship *Volcano* on the 7th of November, and arrived at Malta on the 11th, and was despatched from Malta to Gibraltar by her Majesty's ship *Fire-fly* on the 16th of November, and was due here on Monday the 4th of December".

Alexander's Electric Telegraph

In the *Athenæum* of December 9, 1837, it was said, "We have been admitted this week to a private view of an ingenious model for an Instantaneous Telegraphic Communication, by means of electric or voltaic currents transmitted through metallic conductors under ground, the invention of Mr. Alexander, of Edinburgh. The principle Mr. Alexander uses is to have as many wires as will correspond with the letters of the alphabet and thus, of course, the person in London can by applying the electric influence to any wire apprise a person in Edinburgh that a particular letter of the alphabet is indicated. The expense of such a telegraph from London to Edinburgh is estimated at £100,000. To test the plan, various experiments have been tried in the University of Edinburgh, and we are informed with perfect success. We may further mention that we have this week been invited to inspect a Hydraulic Telegraph and we hope to be able to report on it shortly."

Societies and Academies

Paris

Academy of Sciences, October 18 (*C.R.*, 205, 633-696).

MARCEL DELÉPINE: Obituary notice of Jean Baptiste Senderens.

KENTARO YANO: The change of the coefficients of a projective connexion.

GEORGES TZITZÉICA: Certain quadratic curves and the displacement of a parameter.

DAVID WOLKOWITSCH: The conoid of Plücker.

RENÉ HARMÉGNIES: The torsion of curves traced on a surface.

ERNEST VESSIOT: Partial differential equations of the second order $F(x, y, z, p, q, r, s, t) = 0$, integrable by the method of Darboux.

JEAN DELSARTE: A functional transformation relating to the theory of harmonic functions.

JOHN ELLSWORTH: Rapid changes in the tail of the Finster comet, 1937f. A description of the changes shown by photographs taken between August 2 and 11. There was a second tail, and a marked change in position was shown in two consecutive photographs with an interval of 75 minutes.

LOUIS BERGERON and JOSEPH BETHENOD: The hydraulic tourniquet.

LÉOPOLD ESCANDE: The theory of flow through a depth valve.

MARCEL ATANASIU: Study of natural convection in liquids. Convection in castor oil. An electrical heater is placed in the centre of the castor oil and the temperature differences measured at different points in the oil after the whole has reached a steady state. The convection flow is deduced from these figures. The results are in agreement with the views of Vernotte and experiments of Bory on convection in air.

AUREL NICOLAU: The thermomagnetic properties and constant paramagnetism of the ion UO_2^{++} in some uranyl salts in aqueous solution. Neither uranyl sulphate or nitrate follows the law of Curie or that of Weiss: the paramagnetism is independent of the temperature.

JEAN DEBIESSÉ: Absorption spectra of microbial broths. The growth of micro-organisms in broth produces clear and characteristic modifications in the absorption spectrum. It is suggested that similar observations in the infra-red region and with Raman spectra would be of interest.

ALEXANDRE DUFOUR and FERNAND PRUNIER: The Sagnac effect.

MARCUS BRUTZCUS: The thermochemistry of oxygenated hydrocarbons.

FRANÇOIS BOURION and EMILE ROUYER: The determination of the total hydration of the ions of strontium nitrate.

RENÉ DELAFLACE: The pressure of some permanent gases at low temperatures in the presence of silica gel. The gases studied were nitrogen, oxygen, carbon monoxide and methane. A table is given showing the pressures measured for a range of temperature between -182°C . and -134°C . The figures show that it should be easy to separate the oxygen-nitrogen group from the carbon monoxide-methane group.

CRÉMENT DUVAL: The cobalt hydroxides. By the precipitation of aqueous solutions of cobalt salts with potash, six different precipitates can be obtained, varying in colour. The necessary conditions for the preparation of each variety are given, together with analytical figures.

GEORGES WETROFF: The oxide of phosphonitril. $(\text{OPN})_n$.

LOUIS CHASSEVENT: The hydraulicity of slags.

ALFRED MAILLARD and R. FRIEDRICH: The products formed by the incomplete combustion of light liquid hydrocarbons. The combustion products were cooled to 15°C . and the condensate examined. Results are given for seven different petrolea.

Mlle. MARIE LOUISE QUINET: The classification into two groups of the complex compounds of magnesium chloride with oxygenated organic compounds according to the nature of the oxygen linkage. The (OH) group, water and alcohols, gives complex molecules with six molecules attached to one molecule of magnesium chloride; the $=\text{O}$ group, aldehydes and ketones, attach three molecules; the ether oxide, $-\text{O}-$, gives no complex compound, at least for temperatures above -20°C .

PAUL CHOVIN: Researches on Pechmann's colouring matters. The supposed isomerism of Pechmann and Kugel colouring matters.

JEAN DÉCOMBE: Syntheses by means of β -chloroethylated or β -vinyl ketones. The preparation of some homologues of 1-cyclohexene-3-one.

GEORGES DARZENS: The preparation of some glycerides of phenylacetic acid and their reduction to the corresponding alcohols. Application to the preparation of phenylethyl alcohol.

JEAN BEAUVERIE: The granular structure of chloroplasts: the *grana*.

WERNER MÜLLER and WILLIAM HENRI SCHOFFER: The action of anourin and of its constituents on *Mucor Ramannianus*.

P. BONÉT-MAURY: The optical properties of bacterial suspensions. Four species of bacteria were studied and in each case the optical density was proportional to the bacterial concentration.

F. ARTIGAS: The emission of an ionizing radiation by the total ash of plants. The radiation was found to be proportional to the amount of potassium in the ash.

ALEXANDRE BESREDEKA and LUDWIG GROSS: The role of the skin properly so-called and of the subcutaneous tissue in the evolution of malignant tumours.

Delhi

National Institute of Sciences of India, November 6.

M. ISHAQ: The O-O-Band of OD.

T. S. WHEELER: The theory of liquids.

H. S. PRUTHI and E. S. NARAYANAN: A study of the behaviour of some common varieties of sugarcane in reference to the attack of borers.

D. S. KOTHARI: Joule-Thomson effect and adiabatic changes in degenerate gas.

B. RAMAMURTY: The chemical fixation of nitrogen at low temperature and its significance in agriculture.

M. N. SAHARA and K. B. MATHUR: The propagation of electro-magnetic waves through the atmosphere.

B. N. SRIVASTAVA: Joule-Thomson expansion of a non-degenerate gas.

Moscow

Academy of Sciences (*C.R.*, 16, No. 1, 1937).

KE. SMALICKIJ: The functions of Le Roi, H. Poincaré and V. Stekloff.

M. KELDYS and L. SEDOV: The effective solution of some problems limited by harmonic functions.

STEFAN BERGMANN: Some values in pseudo-conformal images.

J. A. MINDLIN: The boundary dynamic problem of the theory of elasticity for a circle with given displacements.

V. SOKOLOVSKIY: The design of a spherical shell.

V. S. KOSLOV: Determination of the elements of percolation flow under dams with three cut-off walls resting upon a permeable foundation of finite depth.

V. D. KUPRADZE: Solution of the general problem of the diffraction of electromagnetic waves.

V. K. ARKADIEV: The dispersion band and the skin-effect in the sinusoidal field and in the transitional one.

A. PROKOFJEV: Torch ion counter.

P. LAZAREFF: Theoretical study of the influence of mountain ascents and that of winds on peripheral visual adaptation.

N. MIHAL: The determination of the figure of the geoid from the anomalies in the horizontal gradients of gravity.

I. A. SMORODINCEV and A. M. FELDT: Determination of the dissociation constant of thyroglobulin.

M. A. KLOČKO: The 'lake ago' of the Caspian Sea and its volume at the time it became a closed basin.

K. S. ANDRIANOV and A. I. SMIRNOV: The problem of the genesis of vivianite.

P. O. SITKO: Frequency of lethals in the X-chromosome due to the irradiation of spermatozoa in the males and in the spermathecae of the females of *Drosophila melanogaster*.

I. N. KONOVALOV and I. E. ROGAEV: The behaviour of nitrogenous substances during the vernalization of plants.

V. L. RYZKOV and A. M. VOVK: A new disease of the onion (*Allium Cepa*).

(C.R., 16, No. 2, 1937.

V. STEPANOV: Arithmetical demonstration of a theorem of B. Segal.

A. V. JOFFE and A. F. JOFFE: (1) Electronic semiconductors in strong electric fields. (2) Properties of the blocking layer of solid rectifiers.

H. MANDEL and P. KUTEJNIKOV: The full electrodynamics of material media.

N. S. KURNAKOV, A. V. NIKOLAEV and A. G. ČELIŠČEVA: (1) Heating curves of borates. (2) Specific gravity and hardness of natural borates and of the products of heating them. (3) Hydration heat and exothermic transformation of borate into inyoite. Some considerations on the transformation of borate.

V. V. ČELINEV: Explanation of the disposition and inclination of rows of molecules in layers of organic acids according to röntgenograms.

B. P. NIKOLSKIY and V. M. VDOVENKO: The potential difference between solid silver halogenides and aqueous solutions.

A. G. KOGAN and V. I. NIKOLAEV: Studies on the polytherme of the binary system $\text{HNO}_3\text{—HCl}$, and of the ternary system $\text{HNO}_3\text{—HCl—H}_2\text{O}$.

N. A. OBLOV and I. S. MUSTAFIN: Oxidation as a way to the formation of carbohydrates.

V. A. ŠPAK: A new method for differentiating rocks from borings by a counter recording gamma radiation impulses.

N. P. LUPPOV: The age of the "Upper Siderite clays" of the basin of the River Kuban (North Caucasus).

O. S. VIALOV: The mesozoids of Asia.

J. A. EFREMOV: Stratigraphic subdivision of the continental Permian and Jurassic of the U.S.S.R. on the basis of the fauna of early Tetrapoda.

V. I. CALKIN: The distribution of the common dolphin (*D. delphis* L.) in the Black Sea.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, December 6

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—Prof. F. W. Twort, F.R.S.: "A Comparative Study of Filter-passing Bacteria and Viruses" (succeeding lectures on December 8, 10, 13 and 15).*

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Charles Sherrington, F.R.S.: "Jean Fernel" (Thomas Vicary Lecture (1)).

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Rev. W. L. S. Fleming, A. Stephenson and G. G. L. Bertram: "Scientific Work of the British Graham Land Expedition".

Tuesday, December 7

CHADWICK PUBLIC LECTURE (at the London School of Hygiene, Gower Street, W.C.1), at 5.15.—Dr. William Butler: "The Thames Estuary and the Problem of Sewage Disposal of Greater London".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Colonel W. Garforth: "Air Raids as they Affect the Work of the Civil Engineer".

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, Cavendish Square, W.1), at 7.30.—Prof. L. C. Martin: "The Present Limits of Microscopy".

Wednesday, December 8

INSTITUTION OF CIVIL ENGINEERS, at 6.15.—Dr. Brysson Cunningham: "Estuary Channels and Embankments" (Vernon-Harcourt Lecture).

Thursday, December 9

THE ROYAL SOCIETY, at 4.30 p.m.—Dr. R. W. Gurney and Prof. N. F. Mott, F.R.S.: "The Theory of Photolysis of Silver Bromide and the Photographic Patent Image".

Dr. A. L. Reimann: "The Temperature Variation of the Work Function of Clean and of Thoriated Tungsten".

ROYAL ASIATIC SOCIETY, at 4.30.—Prof. Doi: "Japanese Myth and Tradition".

Friday, December 10

ROYAL INSTITUTION, at 9.—Sir George Simpson, F.R.S.: "Ice Ages".

BRITISH INSTITUTE OF RADIOLOGY, December 8–10.—Annual Congress to be held in the Central Hall, London, S.W.1.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MATHEMATICS in the City of Leeds Training College—The Director of Education, Education Office, Leeds 1 (December 8).

PRINCIPAL of the Openshaw Municipal Technical School—The Director of Education, Education Office, Deansgate, Manchester (December 11).

LECTURER IN ANATOMY in the University of Birmingham—The Secretary (December 11).

PATHOLOGIST AND BACTERIOLOGIST in the Memorial Ophthalmic Laboratory, Cairo—Mr. H. H. Rew, The Examination Hall, Queen Square, W.C.1 (December 18).

ASSISTANT in the Observatory at the Cape of Good Hope—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Ref. C.E. 7166/37) (December 21).

GLASS TECHNOLOGIST to the Government of the United Provinces—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (December 21).

METEOROLOGISTS (Grade III) in the Meteorological Office—The Secretary (S.S.A.), Air Ministry, Admiralty House, Kingsway, W.C.2 (December 21).

INSPECTOR OF METALLIFEROUS MINES AND QUARRIES in North Wales—The Establishment Branch, Mines Department, Dean Stanley Street, Millbank, S.W.1 (January 1).

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3554

SATURDAY, DECEMBER 11, 1937

Vol. 140

The University in Modern Life

MORE than one discussion at the recent meeting of the British Association at Nottingham raised questions about the fundamental purpose and functions of the university in modern life which went far beyond the immediate practical problems under discussion. Some of these problems—for example, the part of the university in education for citizenship—had been raised at the conference arranged by the Association for Education in Citizenship at Ashridge in July, while since the Nottingham meeting a lively attack on the inadequacy of the universities in regard to adult education has been delivered by Prof. L. Hogben in a paper "Education for an Age of Plenty" at the conference of the British Institute of Adult Education at Cambridge.

Prof. Hogben criticized the universities for not supplying directly the instruction which is immediately helpful in the task of salvaging democracy, and argued for more courses on public health, nutrition, the social services and the economics of everyday life. The university, of course, teaches the way to sources of such information, but for adult education a special technique is required and its curriculum is not necessarily that which should be followed by the university itself. As Mr. W. Spens pointed out at Ashridge, the university should be an introduction to later life and assist the initial understanding of problems rather than the formulation of conclusions or actual participation in political or economic contests.

The tribute paid to the Modern Greats course at Oxford in itself shows that even in education for democracy the universities have scarcely been so deficient as Prof. Hogben would appear to suggest. None the less, the many and diverse concrete suggestions which have been made as to

the courses which a university should provide and the functions it should fill in a modern democratic society indicate that some fundamental reconsideration of their position is called for if their work is to be reorientated or planned to the better advantage of the community.

Most of the recent criticism of the universities has been concerned with their teaching functions, and a remarkable consensus of opinion has argued that this should be aimed more specifically at imparting the ideal of service and in training for citizenship and for leadership. In the discussion at Nottingham on the training of university graduates for the engineering industry, the importance of a broad training and one which stimulated participation in everyday affairs was repeatedly emphasized by different speakers. It was equally remarkable that not only was premature specialization in technical subjects recognized as undesirable, but also a definite suggestion was made, by Dr. A. P. M. Fleming, that the post-graduate instruction in the highly specialized and technical branches of engineering is a responsibility which the more progressive and larger industrial firms might well be expected to assume.

The significance of this suggestion lies, at least in part, in the fact that it was made by a representative of one of the most progressive firms in Great Britain, who himself has made an important contribution to technical training in that field. Obviously a proposal of this kind would involve very careful examination by all concerned before it could be adopted, but that it should be made at all indicates at least the existence of an atmosphere and a spirit of co-operation, in which the reorganization or reorientation of university courses to avoid overloading or excessive specialization and

to encourage all-round training, creative and independent thinking and the development of personality becomes practicable. The plea for the provision of travelling scholarships for the further training of immediate graduates, to be maintained by industrialists, which Mr. R. H. Clayton has since made in his presidential address to the Manchester Literary and Philosophical Society, is another indication of the increasing readiness of the industrialist to co-operate.

We are here, of course, once more faced with the old question as to whether a university training should be primarily to give the knowledge required to qualify men and women for some special mode of gaining their livelihood, or to equip them as members of society and as human beings. It seems to be clear from almost all recent criticism of the training of scientific workers such as engineers and chemists, however, that under modern conditions even the first objective cannot be realized if the second is neglected. Alike in industrial, commercial and civic life a sense of values and of perspective is demanded of those who hold responsible positions in management or even in the direction of research itself.

The very complexity of the problems with which leadership is confronted in society to-day emphasizes the importance of the cultural elements in a university training, not only because of the large number of those who become leaders in the national life who must have been under its discipline, but also because of the importance of critical intelligence in the rank and file of democracy. Premature or excessive specialization in any branch of science, or indeed elsewhere, is now almost universally condemned, and the dictum that the only specialization at a university should be specialization in the fundamental principles of the science as subject studied commands general support. Dr. Fleming's suggestion, if taken up, might well assist both the universities and the technical colleges to avoid some of the dangers of the past and to concentrate on the fundamental task of turning out trained minds, able to absorb knowledge later in life when left to their own resources, and to take their proper part in the life of the nation.

However important the teaching function of the university may be, the training of men is only one of these functions. Equally important is the conservation of knowledge and ideas. Under present conditions, indeed, as the report of the University Grants Committee pointed out, an exceptional

responsibility rests on British universities owing to the suppression in the universities of several European countries of all independent thought and critical discussion of the principles of government or of the meaning of life. Moreover, as Prof. M. Ginsberg pointed out in a thoughtful address in Section L (Educational Science) of the British Association on the functions of the universities in regard to the social sciences, there are important contributions which university study can offer to the clarification of the issues involved in many social and economic problems to-day, alike in regard to methods and assumptions made by the social sciences and in regard to the problem of values and moral issues. It was never more imperative that universities should be places where thought and disinterested inquiry are pursued on the highest level, and where the best minds of each generation are trained for intellectual achievement. The undoubted need for a re-orientation of our research effort so as to secure a more equable distribution between the social and biological and the physical sciences should not lead us to limit in any narrow spirit the fundamental researches which the university may initiate in any branch of knowledge, or to seek to influence its strictly theoretical approach to such problems. Never, indeed, was it more important that the fundamental research pursued in the universities should be pursued in a spirit entirely free from bias, prejudice or preconceived ideas.

Significantly enough, in the very address in which he suggested that large-scale industry should assume some responsibility for specialized technical training in engineering, Dr. Fleming stressed the opportunities for co-operative research which exist in the engineering departments of the universities but which at present, largely for financial reasons, are far from being fully utilized. Especially is this true of research in borderline subjects which are often outside the scope of an industrial research laboratory. In research no less than in teaching, the possibilities of co-operation between the universities and industry have yet to be fully explored and developed, and co-operation in the way indicated by Dr. Fleming is likely to strengthen rather than impair the independence and resources of the university in regard to long-range and fundamental research on problems the practical bearing of which cannot yet be foreseen.

Under modern conditions, however, it has been suggested that these important functions, of

teaching and training men, and research for the advancement of knowledge, are by no means the only functions which are required of a university. In our swiftly changing world, instructional studies ceases at about twenty-three years of age, and a man is very liable to lose intellectual energy by the time he is forty, and so fail to keep up with advancing knowledge. Sir Richard Livingstone, speaking in Section L at Nottingham, made a powerful plea that the universities should give attention to this problem of arranging systematic refresher or vacation courses at which those especially who occupy responsible positions in industrial, commercial or professional life, whether as managers or directors, should be able to refresh, re-equip and reorientate their minds and guard against the ever-present danger which the numbing effect of routine involves.

Here again, as Sir Richard Livingstone pointed out, is another field for co-operation between industry and the universities. If the special type of adult education required, enabling the student to place his special subject against the background of modern civilization, can only be supplied by the universities, the arrangement of such courses largely depends on the extent to which industry, commerce and the professions are willing to second promising officials for such systematic study. Moreover, it is probable that such a system offers the best means of giving the training in administration and management which is now generally recognized to be so important for those destined to fill the highest positions of management and control in industry. Apart from that, the contact thus established between the university and those with considerable practical experience of industry and the world of affairs can scarcely fail to have a very stimulating and helpful effect on the study of the social sciences at the university itself.

If, therefore, the universities are being called to reconsider their exact functions in our rapidly changing modern society, there is no less insistent call to industry and to society to consider their own relations with the university. The university cannot exercise the new functions unless the society in which it lives recognizes their value and is anxious that they should be performed. Not even in the training of men, whether for citizenship or for industry and the professions, can the university realize its highest ideals unless other sections of the community are prepared to co-operate with it, both by seeing that those entering a university have received an adequate general training, including some for citizenship upon which the university can base its own contribution, and by assisting in the provision of the detailed technical training required to equip those leaving the university for some particular vocation or branch of industry. The redistribution of research effort in relation to the fundamental needs of society and the planning of the reconditioning courses visualized by Sir Richard Livingstone demand as much thought from society as a whole as from the universities. In considering, therefore, the criticism which has been levelled at the universities in recent months, it should not be forgotten, that the highest traditions of the university can only be realized in a community which is willing to co-operate generously with the university. Not even the material endowments of a university are of more vital importance than a true harmony of spirit in which the highest ideals of a university are cherished without as within its walls, and where the community no less than the university is concerned that the tradition of candid and intrepid thinking about the fundamental issues of life shall be handed on unimpaired from one generation to another.

A Life of Lord Haldane

Haldane, 1856-1915:

the Life of Viscount Haldane of Cloan, K.T., O.M.
By Major-General Sir Frederick Maurice. Pp.
xv + 394 + 8 plates. (London: Faber and Faber,
Ltd., 1937.) 18s. net.

VOLTAIRE'S saying, "We owe consideration to the living; to the dead we owe truth only", would have been accepted by Lord Haldane. His autobiography was published soon after his death; and a leading article in *NATURE* of April

20, 1929, discussed especially his services to science and education as set out therein. But Haldane, always an exceptional man, showed a diffidence in his last testament contrasting strangely with the somewhat arrogant conceit of his years of power. The personalities of the small group of politicians who held the destiny of the Empire in their hands during the pre-War years will always be of interest. Haldane's life should be a compulsory subject of study for politicians.

Ironically, Sir Frederick Maurice's life of Haldane, who was a believer in 'wholeness', has been divided into two parts, and the biography is to be published at an interval of a year or so in two volumes. The year 1915, when Haldane's army reforms were being submitted to war's arbitrament and he himself was dismissed from office as Lord Chancellor, forms a natural line of division. To the scurrilous abuse heaped upon Haldane during this hectic year, the answer is now provided. His work in creating the Expeditionary Force is fully justified; and documentary evidence is produced that he urged its dispatch without delay to the seat of war. Some of his highly sculptured reforms proved to be 'snowmen'. His "General Staff", the brains of the Army, melted away at the outbreak of war; his Territorial Army, dubbed by Kitchener as the "Town Clerk's Army", was not used, as Haldane urged on Kitchener that it should be used, as the basis of military expansion. There were faults in his military policy—especially his failure to deal effectively with the grave question of the officering of the Army. The writing must surely have been legible on the wall of the War Office. "If there is one thing," Sir Coleridge Grove told the Military Education Committee on May 16, 1901, after the South African War, "which was shown by the war more absolutely than anything else, it is how enormously short we are of officers at the outbreak of any war. . . . In this last war, I had to get by any means that I could, over 2,000 officers additional to our usual supply in 15 months."

Two thousand officers! A bagatelle compared to the number of officers required during the Great War. Haldane's creation of the Officers' Training Corps was a contribution of great value to this problem; but the role of the Corps after mobilization received no attention. The *liber aureus* concerned itself with the outbreak of war. Afterwards we followed our traditional policy of 'muddling through'. That gifted woman, Gertrude Bell, in one of her letters, remarked that "when people talk to me of our muddling through it throws me into a passion. Muddle through! Why, yes, so we do—wading through blood and tears that need never have been shed." Since the War, there has not been much disposition to brand the culprits for our sins of omission and commission. Silent and abashed we stand before the Cenotaph. In any impartial audit, Haldane's record will show a substantial balance on the credit side.

It is, however, Haldane's services to science and education with which we are chiefly concerned. He was an early convert to the idea of the civic university. Disbelieving in the federal conception as exemplified in the Victoria University of Manchester, he gave evidence before the Privy Council

and assisted in its disintegration. He worked also for the Bill of 1898 which purported to create a civic university in London. His speech in Parliament on that subject is reprinted. "This speech completely changed the atmosphere in the House, and when Balfour, who had come in to help his friend, rose and appealed to the opponents to withdraw their opposition the motion against the second reading was withdrawn." In this speech, Haldane invoked the late Prof. Huxley, "who was a distinguished advocate of this Bill, and who gave evidence before the Royal Commission, in which he laid down a scheme for a university which is now practically embodied in the Bill".

If space permitted, it would be of interest to contrast Huxley's noble conception of a re-organized University of London with the reality. Haldane followed his success with a scheme for establishing a London Charlottenburg at South Kensington. This in the result took an entirely different form from the original plan. "Haldane persuaded Sir Francis Mowatt, then Head of the Treasury, to agree that they [the Royal College of Science and the Royal School of Mines] should be incorporated in his plan." These institutions, by the way, had not "grown out of" the 1851 Exhibition and were administered by the Science and Art Department, not by the Treasury. Mowatt had no more right to de-nationalize them than to give away the King's battleships. Associates and students, traditions and trusts, should not be treated as chattels, even by Parliament. The Government was defeated in 1873 on a question relating to colleges in Ireland; and Gladstone tendered his resignation to the Queen.

We should hesitate to admit that the Imperial College of Science and Technology was "one of the great monuments of Haldane's vision and skill as a negotiator". The question of the proper relation of the technical college to the university was left open. Haldane tells us in his autobiography that he had been unfavourably impressed by the divorce of technical education and university education in Germany and resolved to work for a different plan. The close association of the London Charlottenburg, as originally proposed, with the University of London was fundamental, and the first public announcement was addressed to Lord Rosebery as chancellor of the University.

If Haldane had carried through the original scheme, for which he collected large funds, no trouble would have arisen. Controversy arose under the modified scheme, leading to the appointment of the Royal Commission of 1907. The immediate object of this was to define the relationship which should exist between the Imperial College of Science and Technology and the University, but "at Haldane's suggestion the terms

of reference were widened into an inquiry into the working of the university and the development of advanced education in London".

This suggestion fostered animosities between people who should have been working together *ad majorem gloriam Universitatis*, and deflected an enormous amount of energy in order to create another 'snowman' to add to Haldane's comprehensive collection. To vary the metaphor, Haldane overlaid his own child. The new statutes had been in operation for only a few years. It was unfair to subject the nascent university to an examination only appropriate to an adult organization. The recommendations of the Royal Commission over which Haldane presided "led eventually to the preparation of new statutes". This proposition may be arguable; but the historian should have recorded that the reconstitution of the University under the Act of 1926 bore little if any resemblance to that recommended by the Haldane Commission.

Sir Frederick Maurice, not being a compost of politician, jurist, philosopher (Hegelian and Epicurean) and educationist, will not claim to be the ideal biographer of this multifarious personality.

He has performed a useful task, for which readers in the present and historians in the future will be grateful. Ink is thicker than water, and it was impossible to disguise the fact that Haldane was by nature an intriguer. He must have created a new precedent in writing in 1905 to the King's private secretary to recommend his own appointment as Lord Chancellor—"The Woolsack for me"; and his disloyalty to his own leader, Campbell-Bannerman, stands revealed. "He never sought popularity, and he was not the type of man to whom it came naturally." This is a frank admission. We have to remember, on the other side, the loyalty of some of his friends, particularly Grey and Asquith and Haig. The tributes exchanged in 1915 between Grey and Asquith, reprinted in Trevelyan's "Grey of Falloden" but not published at the time, should have been included. "I cannot express to you," Grey wrote to Asquith on January 25, 1915, "how indignant I feel about the attacks on Haldane"; and Asquith in his reply, after regretting that Haldane was "very much disliked by my own political party", added, "Personally I like Haldane".

T. L. L. H.

The Physical Interest of Eclipses

Eclipses of the Sun and Moon

By Sir Frank Dyson and Dr. R.v.d.R. Woolley. (International Series of Monographs on Physics.) Pp. viii + 160 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 15s. net.

THE chief importance of this book for most readers will lie in the full discussion that it offers on the knowledge as to the physical state of matter in the outer layers of the sun that has been derived from eclipse observations. Naturally there are interesting chapters on the causes and the prediction of eclipses, on the Saros, on lunar eclipses and on the secular accelerations of sun and moon. These chapters cannot contain much new material, but they do give useful references, especially for the last-named subject. We note here one gap in the chapter on the prediction of eclipses that might well be filled in future editions: a reference, at least, might have been given to Dr. Comrie's corrections for a small difference in position in the site of an eclipse camp from the one for which complete data may have been calculated in advance. This would add to the usefulness of the book for an observer on an eclipse expedition.

As was to be expected with Sir Frank Dyson as one of the authors of the book, a full discussion is given of the deflexion of light by the sun's gravitational field. The conclusion reached that Einstein's prediction has been verified, though there may be a small additional displacement to be attributed to some other cause, will be one with which few will quarrel. That future eclipse observations of the Einstein effect should only be attempted when the sun is surrounded by a good field of stars is a sound piece of advice.

An interesting account of the older eclipse observations is given, but some of the space occupied by the account of the early controversies might have been better used, for example, in expanding for the benefit of future observers the chapter on eclipse expeditions and instruments. The most valuable part of the book lies in the account of recent published work, both observational and theoretical, on the chromosphere and corona. Very little has been missed, the most noticeable perhaps being the theory of the corona by von den Pahlen and Kohlschütter (*Veroff. d. Sternw. zu Bonn*, 24). Full attention has properly been paid to the successful results obtained at recent eclipses by Grotrian and von Klüber, and also to the beautiful work on the corona carried

out without eclipse at the Pic du Midi by Lyot. It looks as though we are within sight of the day when the occasional observation of the corona will be replaced by regular daily observations, either by direct photography or by some method such as that now being tried out by the Bell Telephone Company with the aid of television apparatus. Save for the extreme ultra-violet spectrum and for faint extensions, the corona may soon follow the prominences and drop out of eclipse programmes, leaving the field clear for the eclipse observer to concentrate on the important spectrophotometric problems connected with density gradients in the chromosphere and the transition stages at the limb between absorption and emission levels.

It is to be hoped that a future edition will contain a subject index as well as the index of names. There are one or two slips to be corrected. The date of the eclipse observed by Dufay and

Grouiller (p. 133) is 1932 and not 1936; the observations are the same as those mentioned two pages earlier and not a confirmation of them. The duration of totality for the observers in 1926 in Sumatra (p. 57) was 3.2 min. not 4.2 min., which was the maximum possible time of totality for the eclipse. Further, there seems no reason why the principal coronal line at 5303A. should be omitted from the list of coronal lines (p. 149) observed in RS Ophiuchi at its outburst in 1933.

The mention of these minor slips must not obscure the high value and interest of the work to those interested in eclipse observations. The physicist will find the first connected account both reasoned and critical of all recent work on the chromosphere and corona. The observer will have his attention directed to the observations needing confirmation and to the more important problems requiring elucidation.

F. J. M. S.

Pond Life

Ferskvandsfaunaen, biologisk belyst : Invertebrata. Af Prof. Dr. C. Wesenberg-Lund. Bind 1. Pp. vi + 414 + 12 plates. Bind 2. Pp. iv + 415-837 + plates 13-24. (København: Gyl-dendalske Boghandel, 1937.)

IN 1915 Prof. Wesenberg-Lund published a volume entitled "Insektlivet i ferske Vande" in which he gave a semi-popular account of the life-histories and habits of freshwater insects, based largely on the researches of himself and his pupils. As he explained in the preface, one of his objects was to make available to his countrymen, in their own language, the results of researches that had, for the most part, been published in foreign scientific periodicals and in foreign languages. With the same object in view, he has now produced in these two handsome volumes a survey of the remaining groups of invertebrates inhabiting fresh water, omitting the Protozoa, which stand apart and would require a volume to themselves. The theme of the work is the 'biology' (in the German sense) of the animals, their habits and mode of life. Systematics, anatomy and development are considered only in so far as they bear on this subject. At the same time, the abundant and excellent illustrations should enable the student to identify, at least approximately, most of the common species found in Denmark. Since 1930, the author has been director of the freshwater biological station established by the Carlsberg Foundation at Hillerød, and while the researches

carried on there have supplied much of the material for the book (including some hitherto unpublished matter) the survey has been extended to include brief accounts of the freshwater fauna of other parts of the world.

The first volume opens with a memorial notice of Otto Frederik Müller, the great Danish naturalist of the eighteenth century, who was a pioneer in the study of freshwater invertebrates. It is of interest to learn that thirty years ago Wesenberg-Lund drew much of his material from the very fish-ponds in which Müller had worked a century and a half before. Nowadays, it is sad to learn, they are all filled up or so polluted as to be of no further use to the naturalist. The author of the present work has, indeed, much in common with the naturalists of the eighteenth and early nineteenth centuries, whose powers of observation he commends and whose exquisite copper-plate engravings he reproduces in many of his illustrations. Like them, he is primarily interested in the living animals, and although he takes account of the physical and chemical data supplied by modern limnology, the study of the environment is subsidiary to the study of the organism. For him, the microscope is still a more important tool than the thermometer or the photo-electric cell.

In a work of such wide scope it was perhaps inevitable that the treatment of the various groups should be somewhat unequal. The most detailed and interesting chapters are those devoted to the

subjects of the author's own special researches. Thus we have very full accounts of the life-cycles and of seasonal and local variations in planktonic Cladocera and Rotifera, of the wonderful sporocysts of *Leucochloridium*, of the post-embryonic development of Hydracarina, and of the Polyzoa. A particularly attractive chapter is that dealing with the habits of the water spider *Argyroneta*.

Naturally there are omissions and occasional errors in dealing with groups with which the author is not personally so familiar. That favourite of the amateur microscopist, the rotifer *Meliceria ringens* (which we ought now, deplorably enough, to call *Floscularia*) does not build its wonderful tube with faecal pellets, although some of its congeners do. The author frequently quotes the work

of British zoologists, but there are lamentable gaps, showing that he is less in touch with their work than with that of their Continental colleagues. If he had been a more assiduous student of NATURE he would not have overlooked Lowndes' remarkable discovery of *Bathynella* in England, nor would he have failed to notice Gurney's fine monograph of the British freshwater Copepoda published by the Ray Society.

Prof. Wesenberg-Lund expresses the hope that the work may be found of use by the teaching profession. It would certainly be of much use both in schools and in universities in Great Britain to any teachers who would take the slight amount of trouble necessary to acquire a reading knowledge of the Danish language. W. T. C.

Medical and Psychological Aspects of Sociology

A Social Problem Group?

Edited by Dr. C. P. Blacker. Pp. vii + 228. (London: Oxford University Press, 1937.) 15s. net.

IN addition to a foreword by Mr. D. Caradog Jones, who explains the interrogation mark of the title by the intention to raise questions in the reader's mind, and a masterly introduction by the editor, this volume contains nine essays dealing with various aspects of the subject.

The first article, by Dr. A. A. E. Newth, senior school medical officer of the City of Nottingham, on the mentally retarded child, is based on a study of 1,872 children attending elementary schools in the area, of whom 1,388 were feeble-minded and 484 idiots and imbeciles. In his contribution on mental disorder and the social problem group, Dr. Eliot Slater, assistant medical officer to the Maudsley Hospital, has analysed 155 cases of adults receiving public assistance, and comes to the conclusion that apart from mental disorder the social problem group includes considerable numbers of psychopathic persons.

Dr. Tylor Fox, medical superintendent of the Lingfield Epileptic Colony, in a paper based on the study of 250 epileptic children of both sexes, maintains that no answer can be given to the question whether epileptics should rank in the social problem group.

The relation between inebriety and the social problem group forms the subject of a paper by Dr. C. W. J. Braisher, illustrated by cases under his observation at Woodlands Park, where he was formerly medical superintendent. He comes to the conclusion that psychiatrists are generally agreed

that parental and especially maternal inebriety has a profoundly injurious effect on the physical and mental development of the offspring, and that by some means the hereditary disposition to alcoholism is transmitted. Mrs. Sybil Neville-Rolfe, secretary-general to the British Social Hygiene Council, who writes on the biological aspects of prostitution, maintains that the prostitute is a social problem, and should be studied as such, mentally subnormal, psychopathic and over-sexed women forming a considerable proportion of those in the lower ranks of prostitution.

In his article on recidivism and the social problem group, Dr. W. H. de R. Hubert, psychotherapist to Wormwood Scrubs prison, claims that there is a definite relation between recidivism and the social problem group, although there are many gaps in our knowledge of the subject. Mr. E. J. Lidbetter's essay on the social problem group as a public charge contains a number of pedigrees showing the relation between psychological abnormality and destitution. Miss Janet Galloway, psychiatric social worker at the Maudsley Hospital, who writes on neurasthenia and unemployment, has made an elaborate analysis of 52 cases, including family histories, educational attainments, past occupations, military service, age at marriage, number of children, duration of unemployment and neurasthenia, income, housing conditions, food and treatment. The final contribution, by Mr. Caradog Jones, entitled "A Note on the Definition of the Social Problem Group", contains a survey of the previous articles.

The book may be warmly recommended to those interested in eugenics, anthropology, sociology and criminology.

Weeds, Weeds, Weeds

By Sir Charles Vernon Boys. Pp. 72. (London: Wightman and Co., Ltd., 1937.) 1s. net.

This charming little book relates the practical experiences of a very keen observer in eradicating by various methods the common weeds of his farms and gardens.

The earlier pages deal with lawns; the standard lawn sands have proved highly successful, but Sir Charles may have been a little more fortunate than other gardeners on chalk soils, where eradication of weeds from lawns is frequently difficult. A recipe for lawn sand would perhaps help readers who desire to make their own mixtures.

The author has thoroughly tested sodium chlorate as a weed killer against nettles and many other plants, and he recommends its use on drives and paths. He carefully points out the fire danger, and how it may be avoided. The reviewer has seen sodium chlorate effect a thorough clearance of some thousands of the lesser bindweed, pushing up through the surface of a newly made hard tennis-court. Care must be used to avoid any undesirable firework displays during subsequent play! By the liberal use of the hose the chlorate can be washed down below the granite chips, which dry rather slowly when the chlorate is used. Recent letters in *The Times* show the potency of this chemical in eradicating the troublesome *Aegopodium podagraria* L., well known as goutweed, or bishopsweed as it is inappropriately called, for bell, book and candle fail to exorcise it. The author well deserves to be free from such a diabolical weed; there is but brief mention of it.

There are many other practical hints of great value to the gardener concerning humus, monkey jacks and tools. Only a few generic names, for example, *Plantago*, escape a capital letter. This book is truly wonderful value at the price. M. A. H. T.

Borderlands of Language in Europe:

and their Relation to the Historic Frontier of Christendom. By Vaughan Cornish. Pp. x+105. (London: Sifton Praed and Co., Ltd., 1936.) 6s. net.

As an exponent of human geography, Dr. Vaughan Cornish is always stimulating. In the present study, he deals with the debatable borderlands of Europe. As the result of an examination of linguistic frontiers, in which he has traced their history backward, he has in almost every instance been able to arrive at a definite date of origin for such borderlands. This he finds falls within the period when the district under investigation was situated on the frontiers of Christendom. In the west, these linguistic boundaries perpetuate conditions in the political geography of Europe at the time of the collapse of the Western Empire. Thus, for example, the line of demarcation between French and German near Belfort follows the line of the political frontier between Christian Burgundians and heathen Alamannians in the fifth and sixth centuries; while an even more striking instance of the politico-religious frontier is to be seen

in the German-speaking population of the Italian province of Alto Adige, who are the survivors of heathen Bavarians who crossed Rhaetia and retained their pagan customs in the mountains until 730. The like argument is applied to the linguistic frontiers of eastern Europe. For these studies the author stresses the importance of the ecclesiastical map of medieval Europe, which is brought out most clearly in his examination of conditions in Bosnia, as a borderland of nationality and race, where peoples of the same language joined different churches.

Biology for Medical Students

By C. C. Hentschel and Dr. W. R. Ivinney Cook. Pp. xii+664. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 18s. net.

THE second edition of this well-known text-book has been modified to cover the joint syllabus of biology for medical students adopted by the Universities of Oxford and Cambridge, as well as to satisfy the students in the University of London. This has involved descriptions of *Fucus* and several green algae, *Peronospora* among the fungi and the cockroach as an example of an insect.

Apart from these additions, the whole text has been revised and brought up to date.

In spite of the syllabuses, however, the text seems to contain too much for a medical student to grasp in his first year, for he is not studying the subject as a biologist but rather as an aspirant to different ends, using biology as a basic science to his more specialized and more relevant studies. This applies especially to the chapter on evolution and heredity.

The book, however, is well written and as such would form a very desirable introduction for students of biology itself. But while medical students are forced to read such (to them) detailed material in their first year, it is no wonder that the majority of them dislike the subject and ask why they should suffer it.

Systèmes de référence et mouvements (physique classique)

Par Prof. Augustin Seamat. 5: L'Optique des corps au repos. Pp. 365-484. 18 francs. 6: L'Optique des corps en mouvement. Pp. 485-614. 20 francs. 7: L'Esprit de la science classique. Pp. 615-688. 12 francs. (Actualités scientifiques et industrielles, 483-485.) (Paris: Hermann et Cie., 1937.)

THE issue of parts 5, 6 and 7 completes the above volume in this series on classical physics; it is to be followed by one dealing with relativity physics. The present parts cover pre-Fresnel optics, the general theory of wave motion, the electromagnetic theory of Maxwell and the electronic theory of Lorentz, the influence of movement of the source or of the medium on the propagation of light, the drag of the medium, the experiments to test the theories, including those of Michelson, the origin of the idea of action at a distance, material points and their relations, physical time and simultaneity, relativity in physics. The volume concludes with a bibliography of ten pages.

The Pleistocene History of the West Midlands*

By Prof. Leonard J. Wills

THE DIFFERENT TYPES OF DRIFT AND THEIR DISTRIBUTION

THE region I propose to deal with is bounded on the west by the north-south line of hills from the Clees in Shropshire to Malvern; on the south by the Cotteswold escarpment; and on the east by the watershed surrounding the headwaters of the Avon. Its northern limit may be defined by a line from Iron Bridge to Wolverhampton, Lichfield, Tamworth, Nuneaton, Rugby. Within these boundaries there are the two great *vales* of *Severn* and *Avon*, embracing on the west, south and east a triangular plateau drained by the Cole, Blythe and Tame, which carry its waters away northwards to the Trent. In this 'Midland Plateau' is the high ground of the South Staffordshire coalfield reaching, via the Lickey Hills, into East Worcestershire and West Warwickshire, and into the high ground of the East Warwickshire coalfield: the lower ground of the Cole and Blythe valleys between these heights is itself elevated—an upland rather than a vale.

The greatest anomaly in the topography is the valley of the Severn, which is cut, first as a gorge, through what should be a major watershed at Iron Bridge, and later as a sort of groove along the west side of the great vale-like depression the centre line of which lies a few miles to the east. It is probable that in pre-Glacial times the upper Severn went to the Irish Sea, that the watershed of England separated it at Iron Bridge from the middle and lower Severn, which then had its source where now the Worfe rises. From here it may have followed the line of the great depression now occupied by the valleys of the Worfe and Claverley Brook, the Lower Stour, the Elmley Brook and Salwarpe, and the Bow and Piddle Brooks.

A thorough appreciation of the vast extent to which erosion has gone on, and of the enormous length of time involved, at once helps us to understand the apparently anomalous distribution of Glacial drifts in this region, in which, as a rule, the vales and lower ground are free from Glacial deposits, whereas the higher country and the watershed areas are extensively and often heavily drift-covered—a disposition that is the exact converse of the usual arrangement in a glaciated region. I shall attempt to show in the sequel that

the drifts formerly extended beyond the regions where they now form large outcrops, and that their absence from an area need not be taken as an indication that it was never under ice.

The drift-covered areas may be grouped in relation to the major watersheds, as follows:

(1) Watershed between the *Tern* and *Penk* on the north and the *Severn*, *Worfe* and *Smestow* on the south, and between the *Penk* and the *Shenstone Brook*. Towards the north-west it is continuous with the heavily drift-covered plain of North Shropshire.

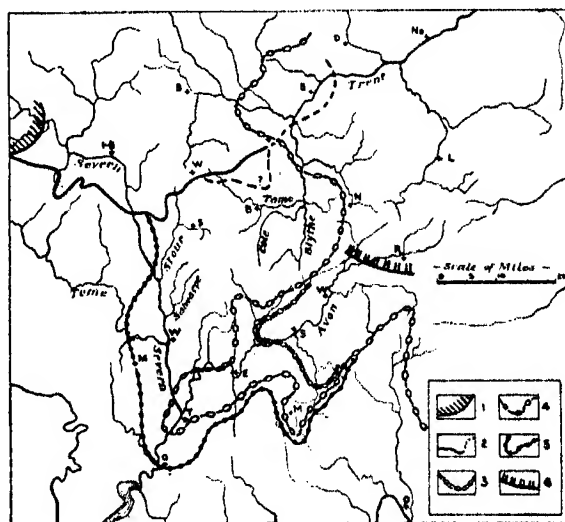


Fig. 1.

THE SPHERES OF INFLUENCE OF THE GLACIERS THAT INVADDED THE MIDLANDS. 1, LITTLE WELSH GLACIER OR 'WELSH RE-ADVANCE'; 2, MAIN IRISH SEA GLACIER; 3, STRATFORD STAGE OF, and 4, SUPPOSED MAXIMUM OF GREAT EASTERN GLACIER; 5, MAXIMUM OF FIRST WELSH GLACIER; 6, POSSIBLE SOUTHERN LIMITS OF A VERY EARLY EASTERN GLACIER.

(2) Watershed between the *Tame* on the north and the *Penk*, *Severn* and *Avon*. This contains most of the Midland Plateau, as defined above.

(3) The watersheds between the *Avon*, *Anker* and *Soar*.

Each of these three areas is characterized by a particular type of drift (Fig. 1). Yet each type is by no means confined to one district, but as a rule has had a wider distribution, evidence for which may in some cases be found in the intervening vales.

In the first or north-westerly district the drifts belong, perhaps exclusively, to the Main Irish Sea

* From the presidential address to Section C (Geology) of the British Association, delivered at Nottingham on September 3.

glaciation. They are full of Scottish and Lake District erratics, and contain fragments of shells picked up from the floor of the Irish Sea. In addition, there is material from Wales; but this, for the most part, has probably been incorporated from the deposits of earlier glaciations. There seems very little evidence of such older deposits still in their original positions.

The Irish Sea glacier advanced inland counter to the drainage, and in our district surmounted the watershed. It is significant that its deposits occur on the watersheds and at the same time reach into the valleys. The southern limit of the Main Irish Sea drifts is shown on Fig. 1. It is generally marked by a great concentration of boulders.

It is now generally accepted that we can divide our British Glacial deposits into 'Older' and 'Newer Drifts'. The *Newer* can be recognized by reason of the freshness and unaltered state of their surface features, which exhibit clearly original forms like kames, *âsar*, kettle-moraine, moraine-lakes, and so on. Their obvious influence on, and relation to, the present drainage is another characteristic feature. On both these counts, the Irish Sea Drifts of this north-western area must be regarded as part of the Newer Drifts. Outside the line marking their limits the rest of the Midlands belongs to the realm of the *Older* series, and has remained extra-glacial since the time of the deposition of the latter.

It is fortunate that the Irish Sea Glacier brought with it a great influx of Scottish and Lake District erratics, for such vast numbers of them found their way into the Severn via the Worfe and Smestow as to give a characteristic lithology to the Main and Worcester Terraces, by which they can be recognized with certainty as later than the terraces which belong to the time of the 'Older Drifts'.

The other two districts belong to the domain of the 'Older Drifts'.

We may consider next the *eastern area*. Here the most characteristic drift is the Chalky Boulder Clay and its associated flinty gravels and sands. Though there are other drifts present, these deposits are proved by superposition to be the most recent. As is well known, the Chalky Boulder Clay was the product of a mighty ice sheet to which Harmer gave the title of the Great Eastern Glacier, the limits of which are indicated on Fig. 1. In the main area, which is that lying east of the Tame and lower Anker, and round Nuneaton, Coventry and Rugby, the drifts are the westward continuation of the great spreads of Rutland and Northamptonshire so clearly delineated on Harmer's famous map of English erratics. From the Soar and Anker valleys there is an extension into the Trent valley. Southwards, the 'Main Eastern'

drifts (of Miss Tomlinson) near Stratford-on-Avon appear also to belong to the Chalky Boulder Clay Series. The same is true of the 'Moreton Drift' of the same author, though this can only be linked with those of Stratford by a series of hill-top occurrences in the otherwise drift-free vale of Avon.

In the last of our three drift-covered areas, the *Midland Plateau*, it is not easy to generalize about the distribution, composition and origin of the drifts. Often they consist of 10-20 feet of pebbly clay, sands and coarse gravel, but there are several districts where far thicker deposits occur. Most of the Warwickshire Plateau has a covering of clayey gravel, sand and sometimes coarse gravel. The high-level drifts of the Ridgeway and of the hill-tops of Worcestershire are chiefly sands and gravels, 'fringe' deposits as Jerome Harrison termed them, implying that they were mainly periglacial in origin. On the Ridgeway there are also areas of clayey ground-moraine.

The composition of the drifts varies somewhat, but they always include a great deal of Bunter material, both pebbles from the Middle Bunter and quartz grains from the sandstones. Next perhaps in number are erratics from the coalfields and from the Wrekin area. North Welsh rocks are often common, many coming from the Berwyns and the Denbighshire Silurian country. Large boulders of Arenig (and ? Aran) origin are common in the district stretching from Walsall through Birmingham and Harborne, and over the Lickeys and Frankley to Bromsgrove. North Welsh material is therefore the most striking of the common far-travelled erratics, and for this reason it is appropriate to term these deposits the *Welsh Drifts*. To them, however, an Irish Sea Glacier contributed Scottish and Lake District erratics on an exiguous scale. We may perhaps infer from the distribution of the latter that they belong to a later stage in the glaciation than that which was responsible for the more southerly Welsh Drifts, these being devoid of the northern elements. It is important to realize that various lines of evidence point to the fact that it was not the Main Irish Sea Glacier, but an earlier one that introduced these few boulders.

Owing to its position between the spheres of influence of the Irish Sea and the Great Eastern glaciers, this central area with predominantly Welsh drifts offers borderline cases where it is difficult to decide to which glaciation a particular deposit belongs. The Kingswinford Esker described by Boulton, and the gravels with many northern boulders at Maney near Sutton Coldfield, provide two examples where it is a question of distinguishing between a Main Irish Sea and a Welsh origin; whereas the drifts of the Ridgeway in East

Worcestershire seem to be compounded of Welsh and Eastern elements.

Over much of that part of the Warwickshire-Staffordshire Plateau which is drained by the upper waters of the Tame, Cole and Blythe, the mantle of drift is comparatively intact, and frequently forms the valley floors; but on the Severn-Avon side of the watershed of England it becomes very ragged, projecting outwards as promontories or forming outliers on the highest hills. This is so far a rule that one is forced to view the capping as remnants of a more or less continuous sheet which once stretched far into the vales of Severn and Avon. Here it has in most places been completely destroyed. Evidence of its presence must be sought for on the hill-tops and not in the valleys, all of which in their present state are younger than the glaciation.

It is, I think, fair to conclude that the ice sheets at their maxima occupied the vales, and that these were far shallower than now. This hypothesis sounds very speculative, but there are some remarkable pieces of evidence in its favour*.

THE RIVER TERRACES AS EVIDENCE OF THE STAGES IN THE EROSION

If we are right in claiming a former far wider distribution of the drifts than the areas where they now occur in force, the river valleys should provide a great deal of evidence concerning the way in which their destruction has been brought about. In the present case this is certainly so; for we have in the Severn and its tributaries a wonderfully developed system of river terraces and of deposits that originated under the rigorous conditions of glacial climates, the so-called taele gravels and melt-water flood gravels.

The farther we go from the plateau and from the drift-covered ground on its north-west and eastern sides the greater the number of high-level terraces. In some cases the geographical distribution and the lithological composition enable us to relate a terrace to a particular set of glacial

* The evidence is discussed in the printed address.

deposits. These points are brought out by the accompanying table.

Severn	Avon*	Height at Mouth of Severn†	Upstream Limit		Composition
			Severn	Avon	
Woolridge	—	† about 200 O.D.	Tewkesbury	—	B, †W, M**
Bushley Green	No. 5	110/75 O.D.	Tewkesbury	Stratford	a few † do.
Kidderminster	No. 4	65/35 O.D.	Bowdley (goes up Stour)	Stoneleigh near Kenilworth Church	do.
Main	Nos. 2 & †3	357/15? O.D.	Coalport (goes up Worfe)	Lawford near Rugby	do. and S
Worcester	? No. 1	?—25 O.D.	Shrewsbury	?	do., do.

* Miss Tomlinson's nomenclature. † Height of top/height of base.

** B, Bunter Pebbles; W, Welsh; F, Flints; M, Malvernian; S, Scottish and Lake District.

I have elsewhere discussed the extremely ambiguous evidence bearing on the question whether there was an interglacial episode between the time of the Main and Worcester Terraces, without being able to obtain an assured answer. On the other hand, the fauna of Avon No. 4 is a warm climate one, which makes it probable that both it and its correlative, the Kidderminster Terrace, are interglacial. The position of Avon No. 4 Terrace below Avon No. 5 which connects with the Great Eastern glaciation, and above the terraces, Avon No. 2 and ? No. 3, which correlate with the Main Terrace of the Severn and so with the Irish Sea glaciation, forces us to conclude that these two glaciations were not contemporaneous.

Various lines of evidence converge, therefore, towards the following conclusion: that the Bushley Green-Avon No. 5 Terrace and the still higher Woolridge Terrace are to be correlated with the 'Older Drifts'; that the Main, the Worcester, and Avon No. 2, and possibly Avon No. 3, Terraces, belong to the 'Newer Drifts'; and that the Kidderminster-Avon No. 4 Terrace records the intervening 'Great Interglacial.' The question whether the older drifts of the Midlands bridge more than one glacial epoch is dealt with in the sequel.

[To be continued.]

Mechanism of the Photographic Process

A GENERAL discussion on "The Mode of Action of the Photographic Plate" in Section A of the British Association meeting at Nottingham, was opened by three speakers, who treated the problem of photography from three different points of view. Mr. E. R. Davies drew a picture of the action of light on photographic materials mainly from physical evidence. Dr. S. O. Rawling gave an account of the action

and theory of development. Prof. N. F. Mott described a theory of light action and latent image formation which was developed on a wave-mechanical basis and which provides an explanation for many hitherto puzzling facts and a useful working hypothesis.

The sensitive layer of any piece of photographic material consists of a thin film of gelatin in which is embedded an enormous number of minute

crystals of a silver halide. Silver bromide is most commonly used and is precipitated in the course of manufacture in a gelatin sol. After various operations which greatly affect the sensitivity to light, the so-called emulsion is spread out on a support and dried down to form a layer about $1/1000$ in. in thickness.

The light-sensitive unit in the photographic layer is the individual silver halide crystal. Its sensitivity manifests itself in two ways. Sufficient exposure to light causes the crystal to darken visibly—print-out effect. Exposures smaller by a factor of $1/10^4$ produce the 'latent image', which makes the crystals developable.

The print-out effect consists of the direct production of silver by the action of light, with liberation of the halogen. If this can be taken up by the surrounding medium the process will proceed to completion. Two points were emphasized. The quantum efficiency is of the order of one silver atom formed per absorbed quantum of light. Light is absorbed all over the crystal, but the silver coagulates and forms specks.

The latent image provides the ever-new problem in photography which cannot yet be regarded as solved. No satisfactory proof of its nature has so far been offered, although the print-out effect strongly suggests that it consists of specks of metallic silver. A few to a few hundred light quanta must be absorbed to make a grain developable. It is difficult to say what effect so few silver atoms could have unless they coagulate to form a speck. Since there is so far no sufficiently sensitive physical method by which the latent image can be detected, we have to use the results of development for its interpretation. A thorough understanding of the process of development is therefore essential.

The latent image acts as a trigger or a catalyst, which enables the developer to reduce the silver halide crystal. Practically all the energy required is supplied chemically, and the latent image itself is lost in the process of development. Developers are often regarded as solutions possessing certain redox potentials. (In the physicist's language, the term redox potential may be explained by saying that the potential measures the ease with which electrons are given off by the solution, a low potential meaning a stronger reducer, giving off electrons more easily.) If the potential is too low, silver halide crystals will be reduced indiscriminately, whether they carry a latent image or not: if the potential is too high, they will not be developed at all. By preparing a series of solutions of decreasing potential it can be shown that at a certain critical potential no development takes place; below that a solution will act as a developer; above it as an oxidizer,

destroying the latent image. Similar results are obtained on a partly developed piece of photographic material, which, of course, contains bigger particles of silver. At another critical potential no change occurs; above it the density is diminished, below it further development occurs. This critical potential is higher than that of the latent image. The conclusion from these experiments is that the latent image silver speck must be above a certain critical size—which cannot, however, be worked out from these data—but below the size at which it would act as solid silver.

These thermodynamical considerations do not tell us anything about the actual mechanism of development. Two essentially different processes have been suggested. One is that the silver halide is dissolved, is reduced to silver in the solution, which soon becomes supersaturated with reduced silver, and the supersaturation is relieved by deposition of silver upon the latent image. From the behaviour of artificially produced silver particles it has been estimated that an aggregate of four or five atoms of silver may be necessary for this action to occur. The other suggestion is that the developer, while not being adsorbed by the surface of silver bromide, which is negatively charged, is strongly adsorbed by a speck of latent image, and from this foothold is able to reduce the rest of the crystal, either through the body or at the interface between crystal and developer. Experiments have shown that some of the commonly used developing agents, which yield negatively charged reducing ions, are indeed only feebly adsorbed to negatively charged silver bromide but are strongly adsorbed to colloidal silver, and that by this very adsorption their reducing activity is enhanced. These facts lend strong support to the second hypothesis.

It is, however, probable that both mechanisms can operate, sometimes together. With some developers, yielding positively charged ions, the deposition mechanism probably operates almost exclusively, and we then have the slow, so-called physical development. With other developing solutions the adsorption mechanism, with direct reduction at the interface between silver and silver bromide, may predominate. This seems to be the more likely action with ordinary commercial development.

Another mechanism is based on the fact that the negative charge on colloidal silver particles is discharged by light, when the particles become developable. A similar process may occur in the bigger silver halide crystals.

Development always takes place in two seemingly definite steps: an induction period, in which no visible changes occur, and the development

proper, which proceeds very rapidly. Unless special precautions are taken, a crystal is either found to be completely developed or not at all. The process of development seems to be an autocatalytic reaction, but the significance of this for the mechanism of development is not clear.

We are thus led to the assumption that the latent image consists of a silver speck of critical size.

The formation of this silver speck was then considered. Light is absorbed all over the crystal and forms isolated silver atoms, which then coagulate into a speck. The distinction was drawn between a primary process, the formation of silver atoms, and a secondary process, the coagulation.

The primary process in latent image formation is strongly influenced by changing the absorption of the individual silver halide crystal. This can be done by dyeing the emulsion with 'sensitizing dyes'. The natural absorption of silver bromide in the ultra-violet and the blue, and with it its spectral sensitivity, can be extended right into the red and infra-red. Silver bromide containing a few per cent of silver iodide is much more sensitive than pure silver bromide; this probably also influences the primary process. The absorption spectrum has mostly been found to coincide with the spectral sensitivity of an emulsion. Sensitizing dyes are always strongly adsorbed to silver halide: an intimate contact between dye and crystal seems essential.

The secondary processes strongly influence the sensitivity, that is, the number of quanta required to be absorbed to make the crystal developable. The sensitivity of crystals increases with their size: coarse grain materials are more sensitive. The explanation is not solely that a bigger crystal will absorb more light and thus form a bigger speck more easily, because it has been found that crystals of the same size differ widely in their sensitivity, which is also influenced by the gelatin and foreign substances generally. The active medium is found to be mainly silver sulphide. There has been much speculation as to the way it acts. Silver sulphide probably forms specks on the surface of the silver halide crystals and acts as a condensation nucleus. Much evidence, mainly of chemical nature, confirms this hypothesis.

Here the present writer would point out that, while the latent image in photographic materials cannot be detected by physical methods, there exists a seemingly strict analogy in big single crystals of silver halide. On illumination with blue light they become coloured and develop an absorption band in the red. On illumination with red light this absorption band is bleached out. This corresponds to the Herschel effect on

photographic materials, where the latent image is bleached out by consequent exposure to red light. Furthermore, the spectral sensitivity of the Herschel effect coincides well with the absorption band observed in single crystals, suggesting strongly that the particles responsible in both cases must be the same. The particles in single crystals are usually regarded as colloidal silver particles, the absorption band being due to colloidal scattering. This, however, leads to impossible dimensions for the silver particles, which cannot, from photographic evidence, be bigger than a few hundred silver atoms. The absorption band observed in single crystals cannot, therefore, be due to colloidal scattering, but must be caused by a more specific absorption process arising from the intimate contact between the silver speck and the silver halide crystal.

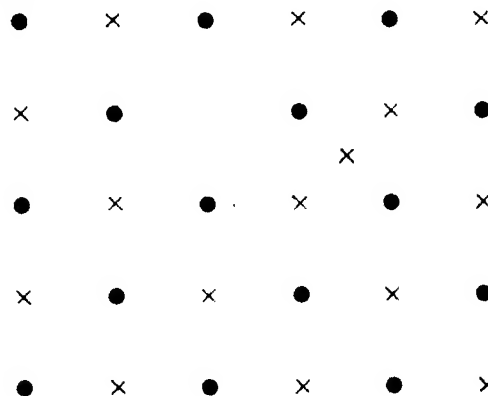


Fig. 1.

IONIC CONDUCTIVITY IN THE SILVER HALIDE LATTICE.

The mechanism of latent image formation was then considered. The crystals are made up from silver and halide ions. In order to produce a silver atom we have to remove an electron from a bromine to a positively charged silver ion. This act is thought to constitute the primary process in photography. In dye sensitization the electron may come from the dye molecule instead. The fact that silver halides are photo-conductors shows that the electron is not very strongly attached to the silver ion, and may move about in the lattice. Calculations show that the mobility of such an electron is almost as high as in a metal.

A speck of silver in contact with a silver halide crystal was considered. There is a certain probability for some electrons to escape from the silver into the crystal, and an electron vapour pressure is set up which depends on the temperature. The speck thus becomes positively charged. The sensitivity specks of silver sulphide may behave in a similar way. Illumination with light increases

the electron concentration in the crystal. If this concentration is higher than the equilibrium concentration of the speck, electrons condense on it. The speck becomes negatively charged and tends to attract the positive silver ions. Silver halides are also ionic conductors; the conductivity is entirely due to the silver ions. A mechanism has been suggested for this ionic conductivity which is illustrated by Fig. 1. At any temperature there are some silver ions in the wrong position in the centre of the cube of four others, leaving an empty space in the lattice behind them. These silver ions have a certain mobility, and so have the holes whence they came. The ions will be attracted by the charged silver or silver sulphide speck and will increase its size, pushing it out of the grain. We

certain density after development, against the intensity, that is, the rate at which the quanta are received. Two facts are most striking; that there is an optimum intensity where a minimum of exposure is necessary, and that with lowering of the temperature the material becomes more sensitive at low intensities—a fact which should be most valuable for spectrography. Since a critical electron vapour pressure has to be reached before the latent image can be formed, at sufficiently low intensities no latent image may be formed at all; since there is a certain chance for recombination of the electrons with the bromine atoms the critical vapour pressure may never be reached. On raising the intensity the critical pressure will be reached for the more sensitive grains in the material, but not

for others; on raising it still further the optimum will be reached. At high intensities there is no difficulty in reaching a sufficiently high vapour pressure, but since the ionic processes take time, it is not unreasonable to assume that the vapour pressure has to be kept up as long as possible for the optimum effect. For too short exposures the ions have no time to move up to the speck, and recombination will take place more readily. At low temperatures the critical vapour pressure is more easily reached, and the biggest effect is obtained at low intensity when the pressure is kept up for a long time.

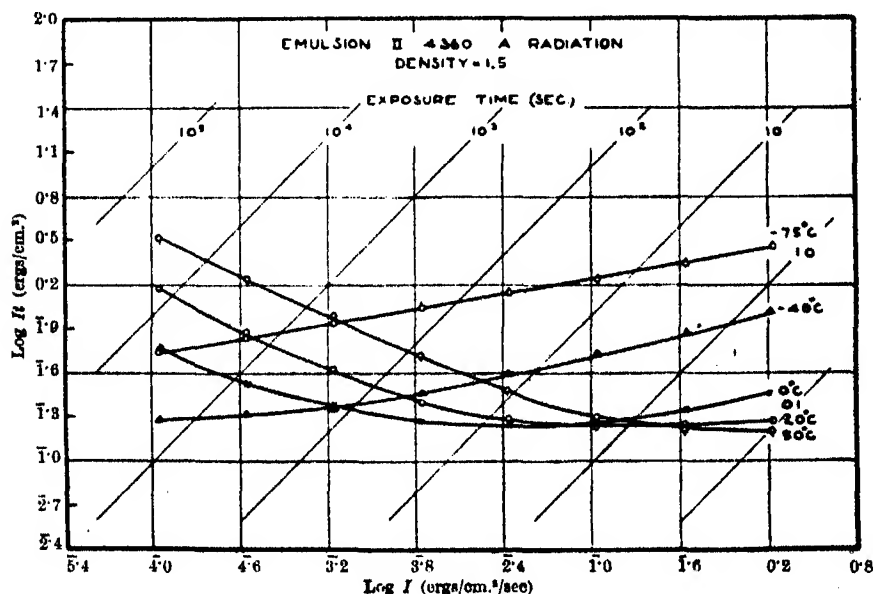


Fig. 2.
VARIATION OF THE RECIPROCITY CHARACTERISTIC WITH TEMPERATURE.

are now left with a neutral bromine atom and a spare hole whence the silver ion came. There is reason to assume that the primary process mostly takes place on the surface of the crystal, so that the bromine atom escapes into the gelatin. Only a slight reshuffle of the lattice is necessary to get rid of the hole, when the crystal will be smaller by one ion pair.

The ionic movements take some time and are dependent on temperature, and it is therefore not surprising to find that the formation of the latent image depends not only on the number of quanta absorbed but also on the rate at which they are fed in, and on the temperature. Much attention has recently been paid to the 'reciprocity breakdown' of photographic materials. In Fig. 2 is plotted for various temperatures the exposure, that is, the number of quanta necessary to produce a

It seems that we have arrived at a fairly simple picture of the mode of action of photographic materials, but it should be pointed out that the picture is by no means complete and will not be regarded as correct by all workers in this field. There is space for mention only of a few more facts which seem important and which cannot or can only partly be explained by our picture. There is solarization, the fact that on prolonged exposure development leads to a partly reversed image; desensitizing by dyes, whereby the material is made insensitive to further exposure while still remaining developable; reversal by dyes, where the latent image is destroyed by subsequent exposure in the absorption band of the dye; and many more. But our picture may be useful as a working hypothesis for future experiments.

W. F. BRAG.

Obituary Notices

Prof. H. B. Fantham

THE death of Prof. Harold Benjamin Fantham, Strathcona professor of zoology and head of the Department of Zoology at McGill University, Montreal, on October 26, in his sixtieth year, has removed one who was widely known for his many contributions to the subject of parasitology.

Prof. Fantham was educated at University College, London, where he was gold medallist in zoology and Derby research scholar, at the Royal College of Science, London, and at Christ's College, Cambridge, where he was twice Darwin research prizeman. He was a fellow of University College, London, and also a member of many scientific societies. In addition to some 150 research papers published in various scientific journals, he was joint author of "The Animal Parasites of Man", in which he wrote the section on Protozoa, and also published a popular book, "On Some Minute Animal Parasites", in collaboration with Dr. A. Porter.

From 1904 onwards, Prof. Fantham was mainly engaged in university teaching, first in London, where he made various contributions to protozoology, especially in connexion with Haplosporidia and the molluscan spirochaetes, and afterwards in Cambridge, where he was assistant to the Quick professor of biology, and conducted work in connexion with the grouse disease inquiry. From there he joined the Liverpool School of Tropical Medicine, where he worked on trypanosomes and spirochaetes, and in conjunction with Prof. J. W. W. Stephens gave the first account of *Trypanosoma rhodesiense*.

During the early part of the Great War, Prof. Fantham acted as parasitologist, and went to Egypt and Salonika where he contracted amoebic dysentery and was invalided home. In 1917 he was appointed as the first professor of zoology and comparative anatomy in the new University of the Witwatersrand, Johannesburg, where he not only organized and developed the Department, but also took a very active part in many university activities, being dean of the faculty of science and also for one year a member of the Council of the University. Whilst in South Africa he was closely associated with the South African Association for the Advancement of Science, and in 1927 was president of the Association, when his address on "Some Thoughts on Biology and the Race" was the subject of an editorial article in *NATURE* of September 10, 1927. In addition, he continued to publish papers, mainly on South African parasitic Protozoa and soil Protozoa.

In January 1933, Prof. Fantham took charge of the Zoological Department at McGill University, Montreal, and at once threw himself with enthusiasm into the task of reorganizing the Department. In addition, he continued research work on Protozoa and eugenics as well as on freshwater biology, and

made special efforts to develop this side of zoological ecology in the province of Quebec.

From the time of his arrival at McGill University, Fantham stimulated the interest of his students, not only those doing advanced work, but also the juniors, with the result that his Department grew continuously in numbers, particularly in research workers. He knew every student personally in his large Department, and would always help in personal as well as academic matters. As a tribute of him they wrote: "The University has lost a Department head, a professor and a colleague—but the students of the University mourn the passing of a friend".

Prof. Fantham is survived by his devoted wife and former student, Dr. Annie Porter, herself a well-known biologist, who co-operated with him in many of his undertakings.

Dr. J. A. Voelcker, C.I.E.

DR. JOHN AUGUSTUS VOELCKER, who died on November 6 at eighty-three years of age, was almost the last representative of the group of men whose work in the application of chemistry to the development of agriculture was of very great importance in the second half of the nineteenth century. The son of Dr. Augustus Voelcker, himself one of the most eminent of the group of agricultural chemists referred to, he was trained to succeed his father, first at University College, London, then at Giessen, and finally at Cambridge. After this he joined the laboratory which his father had established in London. This laboratory was unique at the time, and the methods used there, to which Dr. Voelcker adhered during almost all his life, have become very largely the standards used in similar laboratories all over the world.

On the death of his father in 1884, Dr. Voelcker had, at the age of thirty, the very difficult job of succeeding to the latter's consulting practice and to a number of the public positions which were held by his father. He rose to the occasion, and was for many years the principal and almost undisputed authority on questions of the application of chemistry to agriculture. Perhaps the climax of his career came when he was invited by the Government of India to visit that country and report on the scientific improvement of Indian agriculture. His visit there, in the years 1889-90, was a great success, and his report was the basis for the foundation of scientific work in connexion with agriculture in India. It remains to this day a classic.

When Dr. Voelcker succeeded his father in 1884, he also took over the position of consulting chemist to the Royal Agricultural Society of England, which he retained until his death. His annual reports in this connexion, of which the series is almost unbroken,

will be found a unique record of the changes which have taken place in the character of the feeding stuffs and fertilizers which are used by the farmers of the country. His services towards the purification of such materials have been very great, and his investigations were of importance in leading to the passage of the Fertilisers and Feeding Stuffs Acts in later years.

Dr. Voelcker became director of the Woburn Experimental Station also in 1884, and this remained one of the chief interests of his life from that time onward. The Woburn experiments owe almost everything to his zeal and energy, and rarely has there been much more than a month since he took over charge when he has not visited the experimental station. He only relinquished his position as honorary director in 1936, just after an account of fifty years' experiment there had been published by himself and Sir John Russell. It is a source of great satisfaction that he was able to co-operate in bringing out this monument of what he regarded as, to a large extent, his life-work.

Dr. Voelcker had a special bent for applying scientific results to actual problems, especially agricultural problems. He had, in fact, an almost uncanny knack of extracting, from comparatively simple experiments, conclusions which would stand the test of practice, and, hence, he was in great demand as an adviser in agricultural difficulties. His interest in agriculture was profound, and nothing pleased him more than to spend time on a farm or to associate with those who were responsible for managing agricultural land in any capacity.

On the chemical side, Dr. Voelcker was a prominent member of many of the professional and other societies. He was an early member of the Institute of Chemistry and for long a member of its council. He was also a past president of the Society of Public Analysts, and an old member of the council of the Chemical Society. Apart from his scientific activities, he was a man of very wide interests. An athlete in his youth, when he was a well-known cross-country runner, and a sportsman later in life, he never lost his zest for the one or the other, and he could often be found on a Saturday afternoon attending the events of the London Athletic Club (of which he was twice president).

Mr. C. W. S. Crawley

WE regret to record the death of Mr. Charles William Scott Crawley, which occurred on November 9 at the Corner House, Charlbury, Oxon. Mr. Crawley was seventy-nine years of age and was a partner in the business of the well-known electrical instrument makers—now Nalder Bros. and Thompson, Ltd. He went into partnership with the well-known electrical instrument manufacturers, the late Mr. Francis H. Nalder and his brother, Mr. H. Nalder, two years after the business had started. Mr. Soames was also a partner, and the letters N.C.S. on ammeters and voltmeters are familiar to all electricians.

Mr. Crawley designed many instruments, and was an expert in their actual construction. After he retired from Nalder Bros., he became a consulting

engineer and spent much of his time in the Board of Trade Electrical Standards Laboratory, voluntarily assisting Mr. Rennie. He worked chiefly in the resistance room making accurate comparisons of the standards, some of which had been made by Nalder Bros. in 1892 for the electrical standards committee of the British Association. The work was very difficult as it was known that some of the B.A. coils had changed owing to acidity in the paraffin wax used for insulation. Major Cardew and Mr. Rennie had used them for measuring resistances sent to them for calibration. Mr. Crawley recognized that the weak point in most measurements of resistance was the determination of temperature. At his suggestion, Dr. Guillaume was asked to procure a thermometer of the highest precision.

The provision of a scale of corrections to the thermometer for changes due to the barometric pressure showed Crawley's scrupulous care. He invented 'build-up' boxes for passing from 0 ohms to 10 ohms and so on to 10,000 ohms, using only two mercury cups at a time.

At the International Conference on Electrical Units and Standards in 1908 he was one of the secretaries, the others being W. Duddell, F. E. (now Sir Frank) Smith and M. J. Collins of the Board of Trade. Mr. Crawley, who could converse fluently in French and German, was of great help in explaining matters to the delegates and in showing them around the laboratory of the Board of Trade.

When he went to live at Charlbury, near Oxford, Mr. Crawley equipped a workshop laboratory. He made an instrument for tracing and recording variations of earth currents between buried earth plates. He designed and constructed several barographs for recording variations of atmospheric pressure on a scale twenty times as large as that of a mercury barometer. One of these was sent for comparison of observations to the neighbouring radio station at Leafeld. For many years Mr. Crawley was a member of the Institution of Electrical Engineers and a fellow of the Physical Society. He often attended their meetings and took part in the discussions. He was the pioneer of many new methods of making high-precision measurements which have greatly helped physical and electrical research.

WE regret to announce the following deaths:

Sir Charles Bright, an authority on submarine and general telegraphy, on November 20, aged seventy-three years.

Mr. Henry Crowther, formerly curator of the Leeds Museum, on November 29, aged eighty-nine years.

Prof. A. Lodge, formerly professor of pure mathematics in the Royal Indian Engineering College, Coopers Hill, president of the Mathematical Association in 1897-98, aged eighty-three years.

Dr. D. S. Macnair, known for his work in analytical chemistry, an inspector in charge of the scientific and technical instruction under the former Science and Art Department, on November 27, aged seventy-six years.

News and Views

Queen Mary College Jubilee Celebration

THE tangled tale of the foundation of the colleges of London and of their welding into one of the greatest universities that the Western world has seen is, in its revelation of a complete absence of planning, fascinatingly and characteristically British. None of these colleges has a history more stimulating to the student of social developments than that of Queen Mary College. The College, known until December 12, 1934, as East London College, when Her Majesty Queen Mary presented to the College, through the master of the Draper's Company, a Royal Charter incorporating the College under its new name, finds its origin in a bequest made by Mr. Barber Beaumont, who died in 1841. The eighties of the last century saw the beginning of the generous interest of the Drapers' Company in the movement which resulted in the People's Palace, and on May 14, 1877, Queen Victoria opened the Queen's Hall, and laid the foundation of the Technical School, a School which formed an integral part of the People's Palace. In 1892, Mr. J. L. S. Hatton, to whose almost prophetic insight the metamorphosis of the Technical School is due, was appointed director of that School, and under his wise guidance the work of the School increased so greatly in volume and in importance that in 1907 East London College was recognized as a School of the University of London. The College has indeed been singularly fortunate in its principals. Sir Frederick Maurice, who accepted the office on the death of Principal Hatton in 1933, is steering the College through a difficult period of material expansion marked by a new building scheme, the opening of a high-voltage laboratory and the acquirement of an estate to be developed as a new sports ground.

THE year 1887, which saw the laying of the foundation stone of the Technical School, may be taken as marking the birth of the College, and the College, in holding its Charter week during the week beginning December 12, is also celebrating its jubilee. The outstanding event of the week will be a Congregation on the evening of December 14. The College has now two honorary fellows—Her Majesty Queen Mary and Sir Lynden Macassey—and on the occasion of this Congregation the master of the Drapers' Company, Mr. D'Oyly Monro, and the clerk to the Company, Sir Ernest Pooley, are to be admitted as honorary fellows. The jubilee celebrations mark fifty years of almost unexampled growth, and the College will embark on its journey towards a century of achievement with the good wishes of all who are concerned for the future of university education.

Population Statistics

THE debate in the House of Commons on November 29, on the second reading of the Population (Statistics)

Bill, was interesting on account of the criticism which the Bill received from both sides of the House. The adverse criticisms were chiefly directed against the requirement of information of a not obviously necessary character, and also against the ambiguous nature of the terms of the schedule. The feeling was expressed by Mr. F. K. Griffith that the public should not be worried by "intimate, irritating, and irrelevant questions". There was no general opposition to the asking of information of a definitely useful character. The report of the debate should be read in conjunction with subsequent correspondence in *The Times*. Thus, Mr. A. P. Herbert, in the issue of December 4, mentions the contention of Prof. A. M. Carr-Saunders and Dr. C. P. Blacker that "three pieces of information were essential for the proper elucidation of the trend of the population—the age of the mother and the duration of the marriage at the birth of each child, and the order of birth of each child"; and he remarks that "if this were all the Bill required the trouble would not have arisen".

PROF. MAJOR GREENWOOD, in the same issue, states that "in Germany the age of the mother, the date of marriage, and the order of birth of the child are recorded on the birth-card. Dr. Burgdörfer was therefore able to determine for 1933 the annual frequency of births to married women of different ages and durations of marriages." With this information, he was able to test the question whether fertility had remained constant in subsequent years. That is the kind of information required by statisticians in Great Britain, not now available, but intended by the Bill to be made available for the future. Unfortunately, the schedule to the Bill gave it a much wider and more indeterminate scope, and it is not surprising that objections were raised. The Minister would be wise if he were to confine the schedule to defining the few simple questions, such as those indicated above, which are really indispensable, at the same time eliminating Clause 3 of the schedule, which lays down that particulars may be required with respect to "any other matter" on which statistical information may be wanted for social investigation.

Sir Harold A. MacMichael, K.C.M.G.

THE appointment of Sir Harold A. MacMichael, Governor and Commander-in-Chief of Tanganyika Province, to be High Commissioner and Commander-in-Chief for Palestine and Commissioner for Transjordan in succession to General Sir Arthur Wauchope, who resigns on the ground of health, will be received as singularly well judged. Sir Harold is by personal qualities—which count for much in the East—by knowledge of Eastern mentality, and by long previous experience, peculiarly well qualified to cope with the difficulties of mediating between the

conflicting interests now warring in Palestine. After a distinguished career as a classical scholar at Magdalene College, Cambridge, he joined the Sudan Political Service in 1905, and served in the provinces of Kordofan, Blue Nile and Khartum. During the Great War he served as political and intelligence officer with the expeditionary force which reoccupied Darfur in 1916. A successful official career culminated in the appointment of civil secretary, which he held from 1926 until 1934, on several occasions acting as governor. In the course of his service in the Sudan he became our foremost authority on the ethnology and history of the Sudanese tribes, his published works including "The Tribes of Northern and Central Kordofan" (1912), "A History of the Arabs in the Sudan" (1922) and "The Arabs of the Egyptian Sudan" (1924). For these studies he was awarded the Burton Memorial Medal of the Royal Asiatic Society in 1928. Sir Harold's onerous duties as Governor of Tanganyika have not precluded his continued interest in scientific studies, which has been directed mainly to local archaeology and the foundation of a museum at Dar-es-Salaam.

Memorial to Dr. Samuel Smiles (1812-1904)

ON Saturday, December 4, a bronze tablet to the memory of Samuel Smiles was unveiled at Zion School, Leeds, by Sir James Baillie, vice-chancellor of the University of Leeds. In the course of his speech Sir James said: "Smiles had a singularly sane outlook on human life and a remarkable grasp of the simple elementary principles on which human society ultimately rests. He made himself eminent in his spare time—what we should now call his leisure moments, at the end of busy days. Part of his spare time in Leeds he gave to those who attended Zion School." Smiles's first book, entitled "Physical Education", was published in 1837 at his own expense and reprinted in 1905. Messrs. John Murray published in 1905 his "Autobiography", which contains a copy of his portrait, by Sir George Reid, in the National Portrait Gallery, and in 1857 "Life of George Stephenson", which is an engineering classic. The latter arose from his meeting Stephenson at the opening of the Leeds and Derby railway, later absorbed by the Midland. He collected material during week-ends by interviewing people on Tyneside who knew of the early work, and also he received information from Robert Stephenson and the Peases of Darlington, etc. "Self-Help" arose from lectures he gave in Leeds, particularly one on education of the working classes in 1845. It was published in 1859, after being refused by a well-known publisher. Nearly half a million copies have been printed and it has appeared in the record number of twenty-six languages. In it and in "Character and Duty" Dr. Smiles showed the British people to the world as very virile and inventive. Although trained as a physician he spent most of his working life as editor and writer of books, and from 1845 until 1866 was secretary of two railway companies. He was largely responsible for the Charing Cross railway and terminuses.

In addition to the memorial tablet in Zion School, Alderman P. T. Leigh, chairman of the Library Committee, accepted copies of Dr. Smiles's books in bookcase presented by Sir John Murray for the branch library, which has occupied part of Zion School since 1870—the first municipal free library. Sir Walter Smiles, M.P., presented a picture of his grandfather copied from the oil painting in the National Portrait Gallery, to be hung in the civic hall along with other portraits of Leeds worthies. There was an exhibition of relics concerned with Dr. Smiles: copies of first editions of his early books, autographed letters, family bible and portraits, and the *Leeds Times* of 1838 containing his first speech in Leeds on repeal of the Corn Laws.

Centenary of William Harkness, 1837-1903

ON December 17, 1837, William Harkness, the American astronomer, was born at Ecclefechan, Scotland, his father being a Presbyterian minister. In 1839, the family removed to New York, and after attending private schools Harkness entered the University of Rochester and in 1858 took his degree. A short spell of journalism was followed by the study of medicine, and during the Civil War, at intervals, he served as a volunteer surgeon. In 1862, however, he was appointed an assistant to James Melville Gillies (1865) at the United States Naval Observatory, and it was at Washington that he passed practically the remainder of his life. He observed the solar eclipses of 1869 and 1870, and in 1871 was appointed one of the original members of the Transit of Venus Commission, being concerned with the preparations for the observation of the transits of 1874 and 1882, and also with the discussion of the results. The transit of 1874 he observed at Hobart, Tasmania. In September, 1894, when new buildings had been erected for the Observatory, regulations were promulgated by the Secretary of the Navy providing for the first time for an "Astronomical Director", who was to "have charge of and to be responsible for the direction, scope, character and preparation for publication of all work purely astronomical, which is performed at the Naval Observatory". To this post Harkness was appointed, the office providing, it was afterwards said, "a maximum of responsibility and a minimum of power". To his duties were added three years later the directorship of the "American Ephemeris and Nautical Almanac". The work, however, proved too much; he broke down and in 1899 retired, being granted the rank of Rear Admiral. He died at Jersey City, N.J., on February 23, 1903. Harkness was one of the founders of the Philosophical Society of Washington and in 1893 served as president of the American Association for the Advancement of Science.

Aborigines of Australia

THE petition of eighteen hundred Australian aborigines addressed to the King, and asking for representation of their interests in the Federal Parliament (see *NATURE*, Nov. 6, p. 798), whether it attain its end or not, has at least served to direct attention

once again to the question of their present condition and their future. Difficulties of the situation, which contribute to the failure to find a solution of a problem—for long a reproach to the Australian people—are set out with due appreciation of their weight by an Australian correspondent of *The Times* in an article in the issue of November 25. After pointing out the gravity of conditions which tolerate "tribe after tribe dying on their feet", and contrasting conditions among the natives of New Guinea, the writer refers to the mentality and character of the aborigines as in no small measure responsible for much for the failure of the Governments to check the degeneration which is taking place. Even such a beneficial, and indeed essential, provision in the organization of aboriginal protection as medical attention is rendered in a degree ineffective through the disinclination of the aboriginal to take advantage of it, owing to magical belief or misunderstanding. At the same time the nomadic habit, as well as the tendency to drift to centres of white civilization, neutralize the advantages of reserves of aboriginal lands. On the other hand, the inadequacy of the financial provision made by the Australian Governments is stressed, its most serious consequence being the lack of a trained body of special officers, such as the service organized by Sir Hubert Murray in Papua. A graver indictment of the Australian people appears in the same issue of *The Times* in the form of a report of a valedictory address by Prof. F. Wood-Jones to the Victorian Anthropological Society, which, notwithstanding a certain lack of restraint in language and certain inaccuracies, cannot be passed over by Australia as ill-founded, even though Prof. Wood-Jones, as well as the writer in *The Times*, as has been pointed out in subsequent correspondence, gives little or no credit to Federal and State Governments for what has been attempted to ameliorate aboriginal conditions.

Marconi School of Wireless Communication

QUITE early in its history, the Marconi Company experienced a need for providing its recruits to the engineering and operating staffs with some centralized instruction in the technique of wireless communication. This technique was naturally ahead of any training provided by the universities or elsewhere, and, accordingly, a residential school for the training of probationary engineers of the Marconi Company was opened in 1901. This event established a notable precedent in industrial training institutions. From this date, the School has been in nearly continuous operation, with modifications and expansion of its activities from time to time to meet the demands presented by the progress in communication. Some two years ago it was decided to make very substantial increases in the facilities provided, and on November 29 last, representatives of the technical press were invited to inspect the new buildings and equipment of the Marconi School of Wireless Communication at Chelmsford. Its premises have been rebuilt and equipped on modern lines, its curriculum has been reorganized and additional appointments have been made to the staff.

As a training institution, the School is a leading example of the higher industrial education, and provides the link between the universities and the Research, Development and Engineering Departments of the Marconi Company. All engineering and physics graduates on their appointment as probationer engineers are given a course in experimental and applied wireless communication engineering at this School, which includes in its syllabus the application of circuit theory, the practice of valve, receiver and transmitter technique and experience in the design, construction and testing of representative aerial and feeder arrangements. A series of lectures is also given during the five months' session covering the whole field of wireless communication and a further series on engineering mathematics. The new School possesses a central college building containing the main experimental laboratory, two smaller research laboratories, a standards room, lecture theatre, library, common room, and general offices; and in the grounds are a number of detached buildings housing telephone terminal gear, direction finding plant, transmitters and television equipment. About sixty students are being trained at the present time; the lecture theatre has a seating capacity for seventy-five students and many more than this number can be accepted for work in the various experimental sections of the School. A hostel, with a limited accommodation, is available for those students who desire to live near by. A more detailed description of the School and of the facilities which it provides is given by the principal, Mr. H. M. Dowsett, in the *Marconi Review*, No. 66, May–August 1937.

Iodine in Inorganic and Organic Chemistry

FOR his Friday evening discourse at the Royal Institution on December 3, Prof. Irvine Masson discussed "Iodine". After a reference to the important part played by Sir Humphry Davy in the discovery of iodine (1812–1814) during his honorary professorship at the Royal Institution, the first half of the discourse reviewed the functions of this element in Nature. As a component of rocks, minerals, soils, and dissolved salts, iodine is widespread but is exceedingly scanty. Even in its chief commercial source, the nitrate deposits of Chile, its compounds are present only as minor impurities. It began to be significant, however, when organic life began. Certain marine creatures are rich in it, notably kelp, and in horny sponges (bath sponges) and those corals the skeletons of which are horny, not calcareous. In them, the iodine is in the skeleton, as a well-defined organic compound, di-iodotyrosine, closely related to the fairly simple compound tyrosine, which is a frequent constituent of proteins. Whether the organic iodine is useful to the vital processes of the cell-colony has not been ascertained. The same substance is one of the two iodine compounds in the thyroid gland; and although it there seems to have little or no direct physiological activity, it appears to serve as the chemical forerunner of the other and more complex iodine compound, which the gland evidently synthesizes from it, namely, the hormone

thyroxine. The second part of the discourse exhibited recent discoveries which show that the carbon compounds of multivalent iodine present a much more extensive field than had been realized, wherein this element is seen to be classed less with bromine and chlorine than with elements such as antimony, arsenic, phosphorus, and nitrogen, yet has specific characters of its own.

Chemistry in the Ancient World

THE fortieth Bedson Lecture was delivered on November 26, at King's College, Newcastle-upon-Tyne, by Prof. J. R. Partington, on "Chemistry in the Ancient World". The lecture dealt mainly with the period 4000-1000 B.C., and showed how the outstanding achievements in applied chemistry during this period were made in three principal regions, namely Egypt, Mesopotamia and Crete. The working of metals appears before 3500 B.C. in Egypt and Mesopotamia and somewhat later in Crete and Cyprus. The earliest metal known was probably gold, although copper was known very early in Egypt. The metals silver, lead and iron were also known in the earliest period but were scarce. Refining of gold appears about 525 B.C. An important copper industry was established in Egypt, the malachite ore being mined in Sinai. The use of iron and steel is found among the Hittites and related peoples at the time of the eighteenth dynasty in Egypt, and iron was freely used by the later Assyrians. Brass was known in Palestine about 1400-1000 B.C., and, since the brass industry was later established in Cyprus, some relation between the two regions by way of Râs Shamra seems to be indicated. The techniques of metal workers differed in different regions. The production of bronze was an important event, and the source of the early tin is still doubtful. Zinc occurs in small quantities only in the Roman period. The production of black-topped pottery in Egypt was described and also the preparation of glazes. In some cases the results have been imitated with difficulty and only recently. Glass itself was known in Egypt and Mesopotamia in 3000 B.C., the Egyptians being very skilled in its manufacture and colouring, although blown glass does not seem to have been made until the beginning of the Christian era. The dyes indigo and safflower were used in ancient Egypt, and in Mesopotamia there were the beginnings of the petroleum industry, with extensive use of bitumen for cement and asphalt.

Meteorites of the Gran Chaco

THE announcement in *The Times* of November 9 by a Buenos Ayres correspondent of the discovery of a large mass of meteoric iron in the Campo del Cielo region of the Gran Chaco in the northern Argentine is puzzling. He refers to a "legendary meteorite" long ago spoken of as the "Mesón de Fierro" (iron inn), and assumed to be the source of the iron tips of Indian spears seen by the Spanish conquerors. The discovery of a large mass of native iron in this region was made by Hernán Mexía de Miraval in 1576. This, or perhaps another large mass, was seen

by Miguel Rubin de Celis in 1783, and was described by him in the *Philosophical Transactions* in 1788. The weight of this mass has been variously estimated at from 13½ to 45 tons. Another mass of about one ton, found in 1803, was transported to Buenos Ayres during the war of independence with the idea of manufacturing it into armaments; and a portion, weighing 1,400 lb., of this was presented to the British Museum in 1826 by Sir Woodbine Parish, who described it in the *Philosophical Transactions* in 1834. This is still on view in the Natural History Museum at South Kensington. More recently, a mass of 4,210 kgm. (more than 4 tons) was found in 1923, another of 732 kgm. in 1925, and several other smaller masses. These have been transported to the National Museum in Buenos Ayres. The new report may perhaps refer to the rediscovery of the larger mass seen by Rubin de Celis in 1783; or, not unlikely, still another large mass may have been found. It is suggested that the boundary between the provinces of Santiago del Estero and El Chaco is defined by the position of the "Mesón de Fierro". But as shown on a map of the region (*Geog. J.*, 81, 238; 1933) masses of iron have been found on both sides of this boundary line. Evidently at this place there was an unusually large shower of meteoric irons. The history of the several masses has been given by Dr. Antenor Alvarez "El meteorito del Chaco" (Buenos Ayres, 1926, pp. 222). But the associated meteorite craters, a group of round and shallow depressions (*hoyos* or *pozos*), still require investigation.

Iron Age Site in the Vale of White Horse, Berks

EXCAVATION of an archaeological site at Frilford in the Vale of White Horse, Berks, has afforded interesting evidence of a succession of cultures during a period, which if not prolonged in archaeological perspective, was at least of considerable duration, extending from the early Iron Age to Saxon times. The site lies close to the Oxford-Wantage road, where it crosses the River Ock, and is situated not more than a hundred yards from a well-known cemetery of the Roman and Saxon periods. The excavation, which was undertaken by the Oxford University Archaeological Society at the suggestion of Sir Arthur Evans, was carried out during last term by undergraduate members of the Society with the co-operation of Mr. D. R. Harden of the Ashmolean Museum. The evidence of early Iron Age occupation, according to a report in *The Times* of December 6, is in the form of a series of pits, circular and irregular, dug in the limestone subsoil. These contain Iron Age A2 pottery. In the largest found to date was a large hearth on a clay floor with, among other objects, a polished hammer-stone. In this period the district was remote and backward; but during the Roman occupation a small but well-built villa was erected on the site. This had a tiled roof and tessellated floor. Unfortunately, seekers after stone in later ages have left little of the walls but the foundation trenches, and the floors have suffered similarly. Samian pottery and coins point to an occupation from the first to the end of the fourth century. If this villa

is evidence of the advance of civilization in the area, there are also signs of disturbance, presumably tribal. In the largest pit of the Iron Age a small hoard of late Roman coins, dating from A.D. 370-380, had been buried. In the same pit was a Saxon burial of the sixth or seventh century. The skeleton was well preserved, and with it were a knife and "scramasax". Excavations will be resumed during the Easter term, when it is hoped to determine the date of the villa with greater precision, as well as its relation to the cemetery.

University Functions and Responsibilities

THREE addresses to Victorian political organizations by Dr. R. E. Priestley, when he was vice-chancellor of the University of Melbourne, have been published under the title "The University and the National Life". In the first of these addresses, dealing with the finance and objectives of the University of Melbourne, Dr. Priestley attempts to summarize the functions of a university in a democratic country. First, he considers a university should admit and, if necessary, finance by scholarships, grants and loans, the pick of every generation of the youth of the State, irrespective of the class of homes or society they came from. The university's first duty should be to provide inspiring teaching and the means of full development of body, character and mind for its undergraduate students. For this purpose, research and investigation are essential and the staff must be large enough to ensure adequate contact with students as well as leisure for investigation. The university should aim at sending out graduates whose natural and recognized place would be the front ranks of the occupations they follow and who would be the natural leaders of their generation.

DR. PRIESTLEY also urged that a university should admit interest in, and a certain responsibility for, its men and women throughout their lives, and he stressed the importance of the university extension department as a means of stimulating and satisfying the desire for knowledge which, if democracy is to survive, must become the outstanding characteristic of the average citizen of the democratic state. A university, too, should be a reservoir of liberal and progressive thought, the defender and upholder of all that is best in the thought, customs and traditions in the lives of the people and the State. In his second lecture, on the university and rural interests, Dr. Priestley outlined the ways in which a university agricultural department could assist the farmer. Besides the training of men in the sciences of special importance to agriculture and the carrying out of research on fundamental problems which assists the building up of the fundamental knowledge needed to indicate to the technical worker the most profitable line of attack on his problems, Dr. Priestley stressed the value of the agricultural department as a source of unbiased opinion on agricultural matters. In his third address, on "A Free University", he referred to the value and importance of an adequate scholar-

ship system and to the danger in Australia that efficient representation of sectional views may cause selfish and sectional interests to prevail over national interests. An even graver danger might be the failure to secure the best possible recruits for Australian public services, and only when university graduates are freely recruited for such services is the university making its best contribution to the community.

Staff and Student Stipends in Soviet Universities

ACCORDING to the Soviet Union Year Book Press Service, on November 12 the Soviet Government published a decree changing the regulations governing the payment of the academic staff at the higher educational institutions (universities) of the U.S.S.R. and increasing the stipends granted to students at these institutions. Under the new regulations, the academic staff will be paid on a staff salary basis, instead of on the old system of payment according to the number of hours worked. They will be able to hold a staff position at one higher educational institution only, though at liberty to engage in work at other higher educational or research institutions if they so desire. The salary rates for the upper staff are: directors of chairs at universities, 1,100-1,500 roubles per month (about £42-56), in accordance with length of service; professors, 1,000-1,300 roubles per month; senior lecturers, 700-900 roubles per month. Apart from their salaries, the members of staffs have the advantages of many social services, such as free medical treatment and free school and university education for their children. The new rates of State stipends granted to students at the universities are as follows: students taking a five-year course receive 130 roubles per month for the first year, 150 roubles per month for the second year, 175 roubles per month for the third and fourth years, and 200 roubles per month for the fifth year. Students taking a four-year course receive the same amounts for the first, second and third years, and 200 roubles per month for the fourth year. Students at the teachers' training colleges receive 130 roubles per month for the first year and 150 roubles per month for the second year. Stipends for postgraduate research students will be increased to 400 roubles per month. The number of higher educational institutions in the U.S.S.R. in 1936 was 700, and the number of students in them in the educational year 1936-37 was 542,000.

Mitogenetic Rays?

AN article entitled "An Experimental Study of the Problem of Mitogenetic Radiation", which forms *Bulletin* No. 100 of the National Research Council, Washington, D.C., will be welcomed by many who have waited for an authoritative statement on the reality or otherwise of this type of radiation. The authors, Alexander Hollaender and Walter D. Claus, have spent two years in order to prove or to disprove the existence of the so-called mitogenetic rays. These rays have been defined as radiation comprised between the wave-lengths 1900 Å. and 2500 Å., having an intensity of 10-1000 quanta/cm.²/sec., the claim

being made that they are emitted by biological substances in certain stages of development. It is difficult to see how the authors could have gone further than they have in their efforts to prove or disprove the existence of these rays. Every precaution in the avoidance of errors and a wide range of material and methods of detection have been employed. In spite of this, all the attempts have yielded negative results. Neither biological nor physical detectors gave any indication that a measurable ultra-violet radiation is given out by typical 'mitogenetic senders'. It is a sobering reflection that no fewer than six hundred papers have been published on this subject.

Potato Synonyms

THE report of the work of the Potato Synonym Committee during 1936, recently published, forms a striking contrast to those issued in the early years of the Committee's activities. Whereas in former years a considerable proportion of varieties examined proved to be no more than established varieties under new names, in 1936 all but two were found to be distinct. A great reduction is also recorded in the number of synonyms which continue to be offered in seedsmen's catalogues. The improvement in this respect has been continuous, and as a result of direct correspondence, with few exceptions seedsmen throughout Great Britain now intend to list varieties only under their established names. It should be pointed out, however, that Cherub, Early Favourite and Cleadon Park are identical with Duke of York, Sharpe's Express and King Edward VII (red type) respectively, and that although Midlothian Early and Sir John Llewellyn still appear in some catalogues, they are identical with Duke of York and Eclipse. Dr. Salaman and his Committee are to be congratulated on the outcome of their work. At one time it was not generally appreciated, but we can say to-day that seed growers and buyers alike recognize the value of the efforts made to protect their interests by reducing the many names under which potatoes have in the past been sold. Copies of the report for 1936 may be obtained on application to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

The Royal Society of Arts

THE annual report of the Council of the Royal Society of Arts refers to the establishment of the distinction of Designer for Industry (D.I.) of the Royal Society of Arts as indicating the Society's continued efforts to raise the status of the British artist in industry. Other examples of its interest in this direction are the travelling bursary of £100 offered to art teachers, and the decision to revive on new lines the annual competition of industrial designs which was held from 1924 until 1933. It is hoped that the first of the new competitions will be held in 1938 for the textile industry, and that they will in due course be extended to other branches of industry. The Albert Medal of the Society for 1937 was awarded to Lord Nuffield "for services to

industry, transport and medical science". Fifteen silver medals were awarded for papers read before the Society during the current session. Entries for the ordinary examinations of the Society in 1937 numbered 75,372, and the total number of papers applied for in all the examinations was 93,497. An important innovation under the Thomas Gray Memorial Trust was the decision to award a number of prizes to stimulate and assist the education of apprentices and deck boys. Prizes to the value of £100 were awarded during the year under the Trust for essays and inventions connected with the science and practice of navigation.

A New Garden Periodical

THE first number of *Gardening* made its appearance on October 15. It ministers well to the increasing popularity of the small garden, and scientific processes are portrayed in simple language. Mention may be made of "Secrets of Dutch Bulb Raising" by Kurt Lubinski, and "Wild Trees in the Garden" by Richard St. Barbe Baker. There are, in addition, more general articles on garden design, plant pests and beneficial insects, the storage of vegetables and fruit, manuring, and many other practical problems. *Gardening* is a fortnightly journal, price 4d., and is published by Messrs. Condé Nast Publications, Ltd., 1 New Bond Street, London, W.1.

Aerial Protection in Belgium

THE Ministry of the Interior in Belgium has organized a graduate school of aerial protection in Brussels for physicians, pharmacists, chemists and engineers. A library has been formed to collect international documentation on the subject, and it is anticipated that practical research laboratories will be established. The programme comprises the following features: international legislation, general and special chemistry, general and special pathology, therapeutics, procedures of identification and dosage, principles of individual and collective protection and general organization for protection.

Ramsay Memorial Fellowship

THE following awards of new memorial fellowships for the year 1937-38 have recently been made: A. E. Alexander, a British fellowship of £300, tenable for two years, at the University of Cambridge; T. P. Hughes, a British fellowship of £300, tenable for one year, at the University of Cambridge; Dr. E. de Salas, a fellowship of £300, tenable for one year, at University College, London; Dr. E. C. Stathis, a Greek fellowship, tenable at University College, London; Hazime Oosaka, a Japanese fellowship, tenable for two years, at University College, London; Dr. M. C. F. Beukers, a Netherland fellowship of £300, tenable for one year, at the Imperial College of Science and Technology, London; Dr. J. J. Hermans, a Netherland fellowship, tenable at University College, London. The Glasgow fellowship held by Dr. R. R. Gordon at University College, London, has been renewed.

Finney-Howell Research Foundation

AT the death of the late Dr. George Walker of Baltimore his will provided for the formation of a corporation to be known as the Finney-Howell Research Foundation, the purpose of which was to be the support of "research work into the cause or causes and the treatment of cancer". The will directed that the surplus income from the assets of the Foundation together with the principal sum should be expended within a period of ten years to support a number of fellowships in cancer research, each with an annual stipend of two thousand dollars, "in such universities, laboratories or other institutions, wherever situated, as may be approved by the Board of Directors". Fellowships will be awarded each year on the second Wednesday of March, beginning March 1938. These fellowships will be awarded for a period of one year with the possibility of renewal up to three years. Further information can be obtained from the secretary of the Foundation, Dr. William A. Fisher, Medical and Chirurgical Faculty Building, 1211 Cathedral Street, Baltimore, Maryland.

Meteors

ON November 9, about 21^h 25^m G.M.T., Mr. J. E. Daly, in North London, saw a meteor of magnitude equal to that of Jupiter, moving from the direction of the planet Saturn towards the west. Its motion was nearly parallel to the ecliptic, and its path was over 30°. No other observations of this meteor were reported, so it is impossible to give any details of its real path. On November 20, at 8^h 23^m, a bright fireball was seen by two observers in Rathmines and Mullingar, travelling from south-east to north-west. The body of the fireball gave out an intense bluish-white light, and it had a trail two to three times the apparent diameter of the moon. As it was quite light at the time, it was impossible to describe its path with sufficient precision to enable its height, etc., to be computed. If it had been dark at the time, it is certain that the fireball would have been a very imposing sight.

World Power Conference: Vienna Sectional Meeting

A SECTIONAL meeting of the World Power Conference will be held in Vienna next year on August 25-September 2, by invitation of the Austrian National Committee. The meeting will be followed by one or more 'study tours' of approximately a week's duration. We understand that the British Government has received an invitation to be represented by official delegates at Vienna. The British National Committee, 36 Kingsway, London, W.C.2, has copies in English of the technical programme of the Vienna Sectional Meeting. It is divided into five sections, dealing with the supply of energy for agriculture, small-scale industries, household purposes, public lighting and electric railways. The term 'small-scale industries' is used to cover both handicrafts and industries employing a relatively small number of workmen, about twenty or thirty; in addition,

hotels, cafés, restaurants and shops. The kinds of motive power used should be mentioned: solid and liquid fuel, gas, water power, wind power, steam or electricity, and stress should be laid on those of special importance. Information should be included on the use of human and animal as compared with mechanical power, and the influence of the latter on civilization and health. Technical and economic comparisons between the supply of energy from public electric or gas mains and from private plant would be welcome. Data about lighting power and heat in small-scale industries with special reference to the tools and the drive of the appliances employed, and in particular, room heating, air conditioning, cooking (on a large scale) in restaurants, bakers' ovens and welding. Under the section for the supply of energy for public lighting is included the energy used in traffic lighting, as on railways, for shipping, in air transport, and in traffic control signals.

Announcements

MR. E. HARRISON, director of agriculture for Tanganyika, has been appointed professor of agriculture at the Imperial College of Tropical Agriculture, Trinidad.

DR. JULIAN HUXLEY will deliver the Christmas Lectures (a course of six lectures adapted to a juvenile auditory) of the Royal Institution on December 28, 30, January 1, 4, 6 and 8. The subject of the lectures will be "Rare Animals and the Disappearance of Wild Life". Further information can be obtained from the Secretary, Royal Institution, 21 Albemarle Street, London, W.1.

ON the occasion of the eightieth birthday of Bernhard Nocht, founder of the Institute of Tropical Medicine at Hamburg, the Bernhard Nocht Medal has been awarded to the following, in recognition of their services to tropical medicine: Prof. J. Rodhain (Belgium), Prof. E. Brumpt and Dr. W. Fournieu (France), Profs. E. Martini and E. Reichenow (Germany), Dr. P. Manson-Bahr and Prof. G. H. F. Nuttall (Great Britain), Profs. E. P. Snijders and N. H. Swellengrebel (Holland), Prof. G. Bastianelli and Sir Aldo Castellani (Italy).

MESSRS. E. P. GOLDSCHMIDT AND CO., LTD., of 45 Old Bond Street, W.1, in their latest catalogue, No. 45, offer a selection of important books in the history of science, and also a few early microscopes. Noteworthy items are the astronomical classics, Copernicus' "De Revolutionibus Orbium" (1543), and Kepler's "Astronomia Nova" (1609). They also catalogue that bibliographical rarity, the original edition (1669) of Nicholas Steno's "De Solido intra Solidum", described by Sir Archibald Geikie as "one of the landmarks in the history of geological investigation". The interest of the catalogue is enhanced by many informative notes, and also by reproductions of title-pages and illustrations.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1017.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

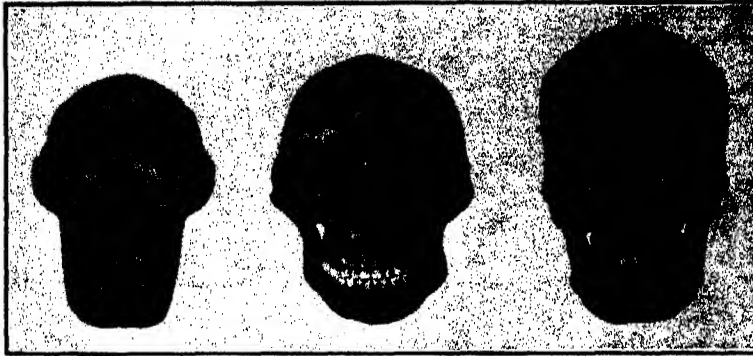


Fig. 1.

RECONSTRUCTION OF THE ENTIRE SKULL OF AN ADULT FEMALE *Sinanthropus pekinensis*. NORMA FRONTALIS. $\frac{1}{2}$ NAT. SIZE. FROM LEFT TO RIGHT: ADULT FEMALE GORILLA—*Sinanthropus*—ADULT MALE NORTH CHINESE.

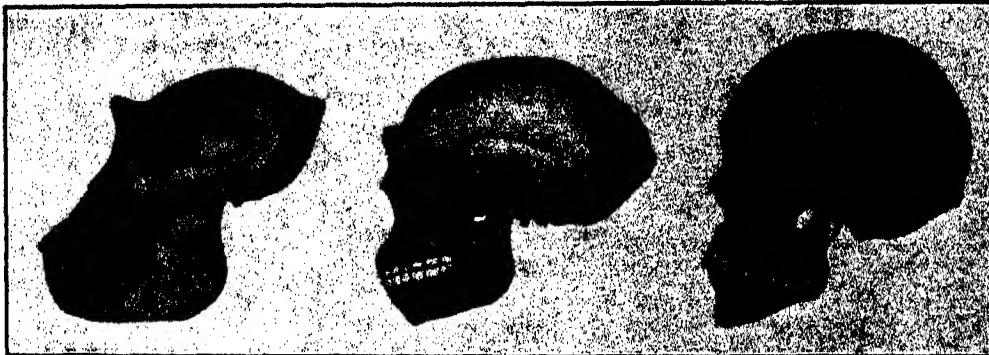


Fig. 2.

THE SAME AS IN FIG. 1. NORMA LATERALIS SINISTRA. $\frac{1}{2}$ NAT. SIZE.

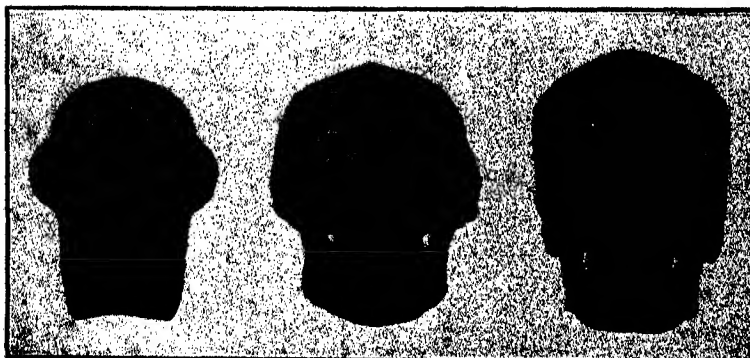


Fig. 3.

THE SAME AS IN FIG. 1. NORMA OCCIPITALIS. $\frac{1}{2}$ NAT. SIZE.

Reconstruction of the Entire Skull of an Adult Female Individual of *Sinanthropus pekinensis*

DURING the last days of our spring excavations in Choukoutien this year, the left side of an upper jaw of *Sinanthropus pekinensis* with six teeth *in situ* was recovered. A preliminary description of this fragment is contained in my publication on the *Sinanthropus* dentition which will be available for distribution towards the end of this year. This specimen, together with other fragments of the facial skeleton of Skulls I, II and III of Locus L, which have already been described in NATURE¹, have made it possible to restore the entire face in connexion with the brain case.

Since the last discovered maxilla

fragment, according to its teeth, apparently belongs to a female individual, the brain case of the female Skull II of Locus L was used as a basis, but the nasal bones, the lateral border of the orbit, the frontal process of the maxilla with

the upper lateral part of the nasal aperture and the zygomatic bone which were unearthed together with Skulls I and III, respectively, belong to male individuals. The reconstruction, therefore, was only a matter of adapting the various parts and of reducing them to the size and proportions given by the brain case—with the preserved supraorbital ridges and the deeper interorbital parts—and the above-mentioned maxilla.

Since the fragments found all happened to be of the left side of the face only, the entire right side was restored on the basis of the left one. The reconstruction of the mandible required very little effort

since the *Sinanthropus* mandible H 1 was available for use¹. The only alteration consisted of adapting it to the breadth of the brain case.

Thus, practically the entire facial skeleton was available, with the exception of a small part of the maxilla between the upper border of the infra-orbital foramen and the lower border of the orbit, and the zygomatic arch from its origin at the temporal bone to the origin of the temporal process of the zygomatic bone. Since the teeth of the female maxilla used for the reconstruction are much worn, no attempt was made to restore them in their unworn condition, and the lower teeth were adapted to approximately the same state of wear. The interior of the left orbit is only partly restored.

The effect of the reconstruction may be gathered from the accompanying reproductions. In order to demonstrate more distinctly the similarities and differences between *Sinanthropus* on one hand and the anthropoids and recent man on the other, *Sinanthropus* in all three views is flanked by the skull of an adult female gorilla and that of a male adult North Chinese. All skulls are orientated in Frankfurt plane (orbitale-porion).

With regard to the details, the reader is referred to my study on the facial skeleton of *Sinanthropus* which is now in preparation. For the present, I only wish to point out that *Sinanthropus* is much more ape-like in appearance than any of the known Neanderthal skulls, and than has been expected by any of the investigators who have attempted to reconstruct the face of *Sinanthropus* on the basis of brain cases only. There is in addition one characteristic difference. In the Neanderthal man the lower border of the zygomatic process of the maxilla declines gradually from the zygomatic bone toward the alveolar process, as in the gorilla (see Fig. 1). In *Sinanthropus*, however, a deep notch separates the maxilla from the cheek bone. This notch is very common in recent man and also in the orang. That we are not dealing with an individual variation as regards *Sinanthropus* follows from the fact that the two maxilla fragments which are at our disposal display exactly this same feature.

The facial fragments of male individuals and the male mandible available suggest that the face of the male *Sinanthropus* may be heavier and the upper jaw more protruding than is evident in the reconstruction of the female individual.

Since the entire reconstruction with regard to all essential parts is based on actual findings and not a single detail is imaginary, the skull can be considered as a real standard type of a *Sinanthropus* woman of advanced age.

The reconstruction was carried out with the kind assistance of the sculptor Mrs. Lucile Swan.

FRANZ WEIDENREICH.

Peiping Union Medical College,
Peiping.

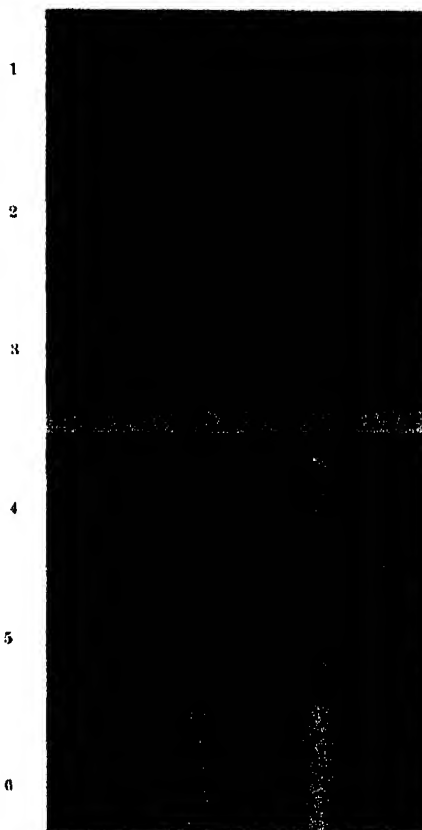
¹ NATURE, 139 (Feb. 13, 1937).

² See Weidenreich, "The Mandibles of *Sinanthropus pekinensis*", 1936.

Structure of Metals

THIS note describes some rather unexpected facts observed when nickel and gold are investigated at high dispersion with X-rays. In these experiments the distance between the film and the specimen is either 20 cm. or 30 cm. The primary X-rays after passing through a pin-hole of about $\frac{1}{2}$ mm. diameter reach the specimen, a flat disk of approximately

1-1.5 sq. cm. surface, and are scattered back to the photographic film. The β_1 line of iron (wave-length 1.75301 Å.) gives with the (400) crystal plane of nickel a glancing angle of $85\frac{1}{2}^\circ$ at room temperature. A lattice change of 1/1,000 produces a shift of more than 7 mm. of the line on the film, and since the position of a sharply defined line can easily be measured to 1/10 of a millimeter, lattice changes of the order of 10^{-4} are observable. No such reflexions are ever obtained when the material is examined in bulk even with the purest and most carefully annealed substances. This is well known. With annealed powders or filings it is different, as is shown for example in the investigation of Owen and Yates¹ on pure nickel.



1, 2, 3. NICKEL FILINGS, HILGER H.S. BRAND, PURITY 99.97 PER CENT. RADIATION, IRON β_1 . CRYSTAL PLANE (400). GRAIN SIZE, BETWEEN 120 AND 200 TO 1 INCH. ANNEALED FROM 700° TO 500° C. FOR 3 HOURS TWICE IN SUCCESSION. DISTANCE, SPECIMEN TO FILM, NO. 1, 20 CM., NOS. 2 AND 3, 30 CM. NO. 3 SPECIMEN ROTATED DURING EXPOSURE.

4, 5, 6. GOLD. NO. 4, HILGER H.S. BRAND, TOTAL IMPURITIES LESS THAN 0.001 PER CENT, FILINGS NOT PASSED THROUGH SIEVE; ANNEALED FROM 600° TO 320° C. FOR TWO HOURS. NO. 5, PRECIPITATED PURE GOLD, HEATED AT 600° C. FOR TWO HOURS. NO. 6, SAME AS NO. 5, BUT SPECIMEN ROTATED DURING EXPOSURE. RADIATION, α_1 AND α_2 NICKEL. CRYSTAL PLANE (422). DISTANCE SPECIMEN TO FILM, 30 CM.

When reflexions are observed under high dispersion as in the present work, very sharp reflexions from the individual crystal grains are obtained, but the surprising fact is that they are scattered over a

comparatively wide range of say about 3-5 mm. on the present photographs, thus indicating lattice variations of the individual crystals of the order of 1/1,000-1/2,000. Extremes are not infrequently found 10-15 mm. from the average position. This average position is found by rotating the specimen in its plane during the exposure. A smooth line now appears on the film, the centre of which is measurable with good accuracy. The lattice constant for pure nickel (Hilger H.S. Brand, 99.97 per cent) thus obtained agrees to 1/10,000 with Owen and Yates' figure.

Photographs made from 99.5 per cent nickel give a larger average spacing. The appearance of the picture is not altered and the spreading of the individual reflexions seems to be the same. Different ways of annealing seem to have little effect upon the appearance of the photographs; on none of the films is there any sign of the narrowing down of the reflexion range. The same holds at higher temperatures near and above the Curie point.

These observations, first made with nickel, hold also for pure gold. Here the α_1 line of nickel as radiation source happens to give high dispersion with the (422) plane in the gold lattice. The reflexions are more irregular in shape, the material not being passed through a sieve. The amount of spreading is of the same order as that of nickel.

It is scarcely to be expected that gold and nickel should in this respect differ from other metals. The conclusions drawn are likely to hold for all metals. The first conclusion is that precision data on lattice dimensions have to be regarded as statistical averages of figures varying over a comparatively wide range of, say, 1/1,000. The reproducibility of the lattice constant of an individual crystal grain is far less than that of the average. It is difficult to see why impurities should be responsible for the effect, since both the less pure and the purest nickel seem to give the same spreading, and that the same should occur with the extremely pure gold with a total impurity of less than 0.001 per cent. The grains themselves must consist of a large number of atoms, otherwise no sharp images could be obtained. This seems to eliminate surface effects. In addition, the nickel filings are kept fairly uniform in size. The crystal grains having different lattice constants cannot possibly all be in equilibrium at a given temperature, and this suggests that the ordinary annealing process is not capable of producing equilibrium.

Further investigations on a considerably larger scale are in progress.

I wish to express my appreciation to Mr. H. Smith for his very efficient help in this work.

ALEX. MÜLLER.

Davy Faraday Laboratory
Royal Institution,
London, W.1.

¹ *Phil. Mag.*, 21, 809 (1936).

An X-Ray Investigation of the Cause of High Coercivity in Iron-Nickel-Aluminium Alloys

It was discovered by Mishima¹ that very good permanent magnets could be produced by the suitable heat-treatment of iron-nickel-aluminium alloys, of compositions near Fe_2NiAl . In search of an explanation, we have made a comprehensive X-ray examination of slowly cooled iron-nickel-aluminium alloys. The results show considerable divergences

from Köster's diagram* (see Fig. 1), and shed new light on the results of earlier X-ray work on the magnetic alloys^{2,3,4}.

Köster's diagram is here reproduced in a simplified form to facilitate comparison with the new results. The nomenclature has been tentatively changed to

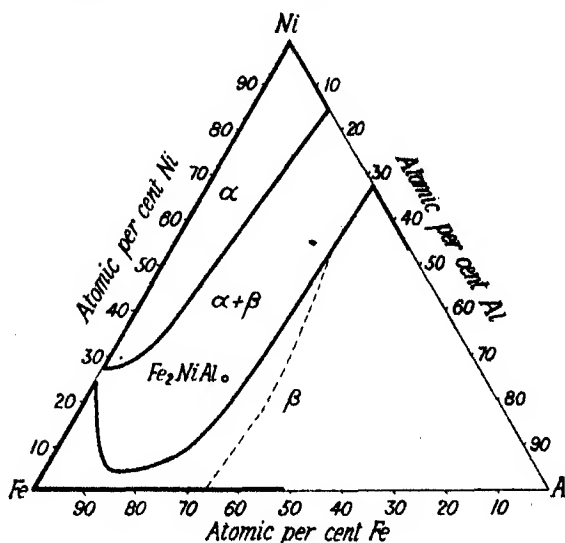


Fig. 1.

FE NI AL BASED ON KÖSTER'S DATA.

one based on crystal structure. Face-centred cubic structures are α , body-centred cubic structures β .

The β area shrinks with falling temperature. An alloy such as Fe_2NiAl , which is single phase just below the melting point, passes into a two-phase

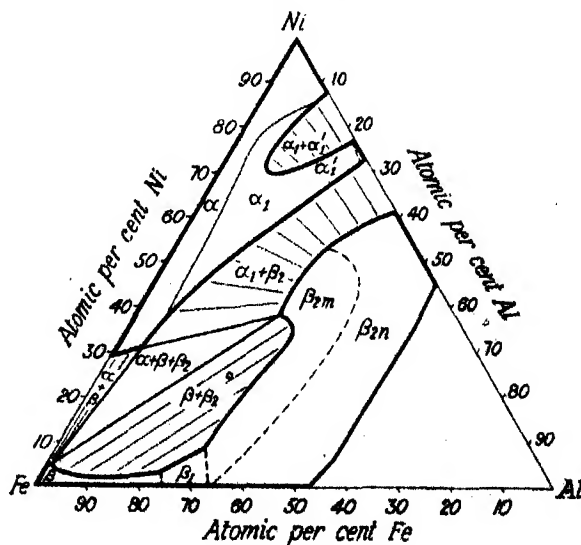


Fig. 2.

FE NI AL FROM X-RAY DATA.

region on cooling. According to Fig. 1, the face-centred cubic phase would be precipitated in this process, but this is not in agreement with X-ray work. We have therefore modified the diagram to agree with our X-ray photographs.

The new diagram (Fig. 2) contains the same single phase areas as Fig. 1, but Koster's two-phase area is seen to consist of four separate fields, $\alpha + \beta$, $\alpha + \beta_1$, $\beta + \beta_2$ and $\alpha + \beta + \beta_2$. The suffixes 1 and 2 indicate the presence of superlattices and m and n distinguish the magnetic and non-magnetic regions at room temperature. It will be seen that Fe_3NiAl lies in the $\beta + \beta_{nm}$ area after slow cooling. Both constituents are body-centred cubic and ferromagnetic; they differ in atomic arrangement and lattice spacing. In the iron-rich β constituent the atoms are distributed at random; in the β_{nm} constituent there is a superlattice in which cube corners are distinguished from cube centres. The lattice spacing of β is 0.3 per cent less than that of β_{nm} .

Burgers and Snoek have shown that the highest coercivity is obtained if Fe_3NiAl is cooled at a given rate. This permits the initial stages of the decomposition to take place without allowing it to proceed to completion. The original body-centred cubic lattice is preserved, but the distribution of the atoms is no longer uniform. We can now make a concrete picture of this intermediate state. Distributed throughout the parent lattice are little 'islands' of the iron-rich β -phase on the point of separating out. In a state of equilibrium they should have lattice dimensions 0.3 per cent less than the parent lattice, but this is not permitted. So long as the structure remains coherent, the iron atoms are held apart in a condition of immense strain. This is the essential cause of the high coercivity.

Further work on this subject is proceeding in co-operation with the Permanent Magnet Association and the Electrical Research Association.

We are greatly indebted to Prof. W. L. Bragg for his kind interest.

Physical Laboratories,
University,
Manchester.
Sept. 20.

A. J. BRADLEY.
A. TAYLOR.

¹ Mishima, T., *Stahl u. Eisen*, 53, 79 (1931).

² Koster, W., *Archiv. Eisenhutt.*, 7, 257 (1933-34).

³ Weretschlagan, L., and Kurdjumov, G., *Tech. Phys. U.S.S.R.*, 2, 1 (1935).

⁴ Glocker, R., Pfister, H., and West, P., *Archiv. Eisenhutt.*, 8, 561 (1934-35).

⁵ Burgers, W. G., and Snoek, G., *Physica*, 2 (10), 1084 (1935).

Double Structure of Chromosomes

THE structure of chromosomes has been a matter of such diversity of opinion and interpretation that it is desirable that certain points at least, which can be definitely settled, be removed from the region of doubt. *Trillium* is a plant genus with chromosomes so large that their component threads are far above the limits of resolution with the microscope. They are therefore not subject to the doubts and criticisms sometimes expressed concerning observations on the structure of chromosomes which are much nearer the limits of visibility.

Recent observations in my laboratory, of chromosomes in the root tip mitoses of *Trillium sessile* from preparations of Mr. S. V. Mensinkai, show undoubtedly that the metaphase chromosomes (Fig. 1) consist of four strands twisted about each other in pairs, while the anaphase chromosomes (Fig. 2) contain two spiral chromonemata clearly embedded in a matrix, and cannot by any stretch of the imagination be regarded as single. At the ends of the chromosome the two chromonemata generally converge so as to meet end-

to-end and form a rounded tip to the chromosome. This can be seen at several places in the accompanying figures. In other cases, as at the points marked a in Fig. 2, the uncut end of a chromosome shows the two chromonemata diverging or running parallel.



Fig. 1.

METAPHASE CHROMOSOMES OF *T. sessile* ($\times 3000$).

Whether these chromonemata are themselves double, as some cytologists hold, remains to be determined by further observations. It can, at any rate, no longer be reasonably contended that anaphase and telophase chromosomes are single structures and that the split in the threads must therefore occur



Fig. 2.

ANAPHASE CHROMOSOMES OF *T. sessile* ($\times 2200$).

invisibly in the resting nucleus. This being the case, the hypotheses which Darlington¹ and others have put forward on the assumption that the anaphase chromosomes are single structures are invalidated. This includes Darlington's view of the relations between meiosis and mitosis. This hypothesis,

involving the single nature of the leptotene thread, is also contrary to other recent critical observations of the early meiotic threads in *Trillium* and various other plants.

The attempts made by various investigators to use the results of X-ray fragmentation of chromosomes as crucial evidence for the time at which the somatic chromosomes split have resulted in failure. This appears to be because each investigator has been able to interpret his results as supporting the ideas he previously held, so that the method is not discriminative.

R. RUGGLES GATES.

King's College,
London, W.C.2.
Nov. 11.

¹ "Recent Advances in Cytology" (1937).

Blindness in Freshwater Fish

THE CAUSE of blindness in freshwater fish is frequently sought by owners of fishing waters and fish farmers. Usually the blind fish are old fish and have lost the gift of sight in one eye or both due to some growth behind the eyeball or some accident to the front of the eye.

Recently a number of yearling rainbow trout were received from a trout farm in which some fish were blind in both eyes. Apart from the blindness, the fish were in very good condition as regards colour and weight. Investigation revealed the cause of blindness as being due to the presence of about forty living forms of the larvæ of the trematode *Diplostomum volvens* Nord. in the lens. The life-history, or as much of it as is known, is recorded in Plehn's "Praktikum der Fischkrankheiten" and taken from trout, whereas in America it has been taken from Black bass, etc.

So far as I am aware, it has not been previously recorded in Britain.

The life-history is, briefly, as follows: The principal host is a water bird, usually a gull, and inhabits the gut of the bird, where its sexual cycle takes place. The fertilized eggs pass out with the droppings and, if taken up by a freshwater fish, find their way via the gut to the blood stream to be carried ultimately to the lens of the eye, where the eggs give rise to the larval stages of the worm, causing the lens to lose its function.

In some cases the lens becomes so swollen up as to burst through the outer coat of the eye, and liberates the larval forms into the water. If the fish or the lens is eaten by a water bird then the bird becomes infected and can be a further source of infection to other fish.

Whether there is any intermediate stage between the fish and the bird does not appear to be known; and whether the larval form liberated from the fish can infect other fish is not given in the records.

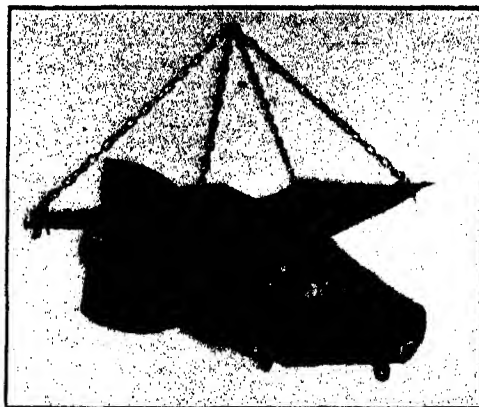
The larval forms in the lens of the infected fish were of varied shape, and only when about to be liberated had they the well-known fluke form. Sizes up to 0.3 mm. were seen.

W. RUSHTON.

Biological Department,
St. Thomas's Hospital Medical School, S.E.1.
and
Salmon and Trout Association,
Fishmongers Hall, E.C.4.
Nov. 1.

A Plankton Collector for Fast Towing

DURING the course of an investigation of the *Sagitta* population in a portion of the Irish Sea, it became desirable to sample the waters over a large area. An attempt was made to devise a tow-net which could be used on coasting boats, the speed of which is approximately eight knots. An instrument was designed (Fig. 1) on a similar principle to Hardy's model¹ but with several modifications. It consists of a diving fin to which is attached the plankton collector with an internal conical silk net.



PLANKTON COLLECTOR FOR FAST TOWING. The rear chains were shortened for photographing. (PHOTO. BY P. BOND.)

The body of the plankton collector is a cylinder ten inches long and seven inches in diameter with cones on each end. The front cone is 6½ in. long with a mouth opening 2½ in. in diameter. This size mouth opening gave a ratio of one to 6.5 between the cross-sectional areas of the mouth and cylinder. The front cone is detachable, fitting into the cylindrical body by means of a wide collar. The inner end of this collar is tapered slightly and rimmed. The mouth of a small conical, coarse silk net 10 in. long is fitted over this rim and tied; at this point the incoming water is slowed down to its minimum rate of flow. A small wide-mouth jar was fastened to the end of the net to hold the filtered plankton. The cylindrical body of the instrument is bolted along the short axis of the diving fin, which is 22 in. long and 11 in. wide. To each corner of this rectangular sheet iron fin a chain is attached; all four chains fastening through a shackle by means of which the device is towed.

An early model with two side fins was successfully tested, through the courtesy of Prof. T. B. Abell, in the tanks of the School of Naval Architecture at Liverpool. In use, the instrument made from this model was unsuccessful. It was unstable and would dive only for very short periods. The side fins were later discarded, and a sheer-board was substituted, as described above. In this form it was successfully towed from a motor-boat at about five knots. Catches of living *Sagitta* and additional plankton were taken in the small jar fastened to the end of the net. These catches were comparable to those made at the same time in a coarse silk tow-net.

Owing to lack of time for further tests at increased speeds, the instrument was at once used from a cargo boat running at about eight knots between Liverpool

and Whitehaven. During this trial the diving fin was found to be too light in construction; it bent under the increased pressure, and the body was lost.

It is hoped to continue experiments with this type of collector in the future. The instrument can be made inexpensively, and may be of great service for collecting uninjured living plankton quickly over a wide area in the sea or in lakes. I am indebted to Prof. J. H. Orton for assistance and advice in this work.

E. LOWE PIERCE.

Dept. of Zoology,
University, Liverpool.
Nov. 15.

¹ Hardy, A. C., *J. Mar. Biol. Assoc.*, 21, 147-177 (1936); "Discovery" Reports, 11, 457-510 (1936).

Refractive Indexes of Helium I and II

THE refractive indexes of liquid helium I and II have been measured by the use of a Wollaston cell as previously described¹.

The values obtained for the index for λ 5461 Å., with their estimated errors, were as follows:

	Temp. (° K.)	Critical angle	Refractive index	$\frac{\mu^2 - 1}{\mu^2 + 2} \cdot \frac{1}{\rho}$
He I	4.22	78° 28' ± 20'	1.0208 ± 0.0012	0.109
He I	2.26	78° 51' ± 5'	1.0289 ± 0.0004	0.122
He II	2.18	76° 51' ± 5'	1.0289 ± 0.0004	0.122

These values agree with the preliminary value 1.028 ± 0.006 obtained by Wilhelm and Cove² for the index for helium II. The value of μ^2 at 2.18° K. is 1.0545, which corresponds closely to the dielectric constant $K = 1.0558$ ³.

In order to ascertain whether there was any difference in the molecular refractivities of helium I and II, the observing telescope was set on the critical edge in He II at 2.18° K. Then the temperature was raised through the λ -point to 2.26° K., where the density is the same to within 0.00005. In passing from one temperature to the other several times no change in the position of the critical ray resulted. A change of one minute of arc could have been detected easily in this way. Therefore the index changes by less than 0.00007 in passing from a point in He II to a point with the same density in He I.

The work was carried out by Prof. J. O. Wilhelm, Mr. H. E. Johns and Prof. Grayson Smith.

E. F. BURTON.
(Director).

McLennan Laboratory,
University,
Toronto.
Nov. 4.

¹ Johns, H. E., and Wilhelm, J. O., *Canadian J. Research*, 15, 101 (1937).

² Satterly, J., *Rev. Mod. Phys.*, 8, 347 (1936).

³ Wolfke, M., and Keesom, W. H., *Leiden Comm.*, 192 A.

Natural Activation of Papain

WORKING with latex of *Carica papaya*, we were able by different methods (dialysis, precipitation, etc.) to separate the natural activator from the enzyme system.

When solutions containing the activator were added to a latex preparation ('centrifugate') which split up gelatin, but not peptone, peptone hydrolysis was induced; with commercial papain, again, the otherwise small peptone hydrolysis was considerably enhanced. No increase in the hydrolysis of gelatin

on addition of the natural activator solutions was observed; in many cases a decrease in activity was actually produced. The activator solutions showed *inter alia* strong sodium nitroprusside and ninhydrine reactions and gave the characteristic cuprous salt on treatment with cuprous oxide in acid solution. The solid residue obtained on decomposition of the cuprous salt showed the properties of glutathione. The admixture of this product with pure glutathione did not produce a pronounced depression of the melting point.

On adding pure glutathione to 'centrifugate' or to commercial papain, the induced or, respectively, enhanced peptone hydrolysis observed even at comparatively low concentration of glutathione reached the value attained on activation by prussic acid. Hydrolysis of gelatin by the same enzyme preparations, on the other hand, was decreased by addition of small quantities of glutathione. When, however, greater quantities of the latter were added, the primary inhibition was annulled, and with comparatively large amounts of glutathione, stimulation of gelatin splitting was observed.

The chemical behaviour of the natural activator, and the corresponding action of the natural activator and of glutathione on the hydrolysis of peptone and gelatin, make it probable that the natural activator is glutathione. A decisive proof on this question must await complete chemical analysis. For seasonal reasons, some months must elapse before the large amount of latex required for the preparation of sufficient material for a full chemical analysis will become available to us. A final and detailed report will be published elsewhere at a later date.

MAX FRANKEL.
R. MAIMIN.

Hebrew University,
Jerusalem.
Nov. 2.

Standardization of Potato Slopes for Bacteriological Tests

It is common to find differences in the growth of sub-cultures of the same bacterium on potato slopes, and it also frequently happens that there is a percentage of unsatisfactory slopes in a batch of potato medium after sterilization. Possibly our experience in trying to standardize this medium for work in this laboratory may be of use to other microbiologists.

Thirteen varieties of potato have been tested, and all of them have been used fairly soon after lifting. The cut blocks are washed in running water for at least 12 hours, and then put in test tubes resting on a small wad of cotton wool, and the tube is filled with distilled water until the potato wedge is completely covered; this water is poured away after sterilization just before the tube is inoculated. The substitution of normal saline solution does not improve the final character of the slope. We have tried various methods of sterilizing to see whether this effects the condition of the wedge: steaming on three successive days, autoclaving once for fifteen minutes at three different pressures, namely, 5 lb., 10 lb. and 15 lb., and autoclaving for five minutes on each of two successive days at the same three pressures.

The results from these different methods are not conclusive. In every case the sterilization has proved adequate, since no contaminations have occurred, at least within a period of six weeks, but, on the whole, the wedges remain in better condition after two short

periods of autoclaving rather than after one longer one. The varieties of potato tested which make 100 per cent good slopes after all treatments are Majestic, Epicure, Red King and King Edward; those which are definitely bad are Katriona, Sharpe's Express and King George; while Arran Banner, Duke of York, Dunbar Cavalier, British Queen, Arran Comrade and Great Scot are variable. It is possible that the degree of ripeness of the potato may be one factor which determines the character of the slope in these variable cases.

The bacterial growth obtained on the varieties used is also variable, especially in the case of pigmented species. There is no question in these experiments that Majestic promotes the greatest and most typical growth, while Epicure, British Queen and Arran Comrade are also good. Among the other varieties there is little to choose from the point of view of amount of growth, but the type of growth may be different. The following descriptions of cultures of a soil species of *Flavobacterium* when grown on potato slopes emphasize this point:

Dunbar Cavalier. Scanty, pale yellow streak, just raised, smooth, glistening, dry.
Great Scot. Moderate, cream to yellow, raised, slightly nodular, glistening, slightly moist.
Arran Banner. Moderate, pinkish, raised, slightly nodular, glistening, moist.
Sharpe's Express. Moderate, canary yellow, slightly raised, smooth, glistening, dry.

It seems that for comparative work it is essential to use the same variety of potato, and from all points of view Majestic is a very satisfactory variety.

D. WARD CUTLER.
MABEL DUNKLEY.

Department of General Microbiology,
Rothamsted Experimental Station,
Harpenden, Herts.
Nov. 4.

Axial Spin and Weapons of the Ancients

As one interested primarily in linguistic studies, I should like to suggest two points, one in confirmation and to amplify, the other a query, arising from Sir Gilbert Walker's article on "Mechanics of Sport" in *NATURE* of October 2.

That the ancients were aware, at least empirically, of the steadying influence of a movement of rotation about its longitudinal axis on an object also endowed with the motion of translation, is beyond doubt. This spin can be communicated by the thumb and fingers (as in throwing the assegai); or by a cord (the 'becket') which unwinds and is left in the hand. The becket corresponds to the Roman *amentum* and the Greek ἀγκύλη, which are often mentioned in connexion with the throwing of spears. Sir Gilbert cites becket and *amentum*; but one can go further. In Latin it is curious how constantly the verb *torqueo* ('twist') and its derivatives are used of throwing a spear. Virgil alone employs *torqueo* and its compounds about sixty times of hurling projectiles. This was pointed out by R. F. T. Crook¹, who convincingly deduced that the choice of the verb *torqueo* implied the imparting of an axial spin. The imposing array of evidence which he adduces makes this view much more likely than the older interpretation, that

torqueo referred to a preliminary 'flourish' or brandishing. Last year² I attempted to develop this idea, showing that πάλλω was used in Greek of communicating precisely the same twirl to a spear; an explanation which, if true, incidentally provides a very simple etymology for πάλλω.

The flight of the arrow raises the question to which I should be glad to receive an authoritative answer. Did the ancients, by feathering their arrows with truncated wing feathers, arranged in cyclic regularity of bias, impart a slight rotary spin to the arrow? Illustrations on vase paintings suggest this arrangement. So, too, the modern practice, apparently. "The fletcher selects feathers from either one wing or other of the bird."³ There is also in Duff's practical manual a diagram of a transverse section of a feathered arrow, showing "the screw-like relation of the tips of the feathers (p. 128). A correspondent to *The Times* (Feb. 17, 1936) writes: "It is essential that the feathers should curve the same way, to impart a slight rotary motion to the arrow in flight, and therefore, since the feathers curve differently on each wing, all three (feathers) should be from the same one." On the other hand, I have often heard it stated that the feathered arrow flies steadily—on an even keel, so to speak—like a miniature aeroplane. Sir Gilbert Walker writes of the function of the feathers as merely providing resistance at the rear end (to prevent the arrow slewing round to fly with its length at right angles to its path). This, too, is, I think, the popular idea of an arrow's flight—compare "as straight and steady as an arrow". Does an arrow rotate?

Department of Latin,
University College,
Cardiff.
Nov. 3.

L. J. D. RICHARDSON.

¹ *Classical Rev.*, 80, 46-8 (1916).

² *Trans. Philolog. Soc.*, 101-5 (1936).

³ Duff, J., "Bows and Arrows".

Boron in Agriculture

THE importance of boron in agriculture is now well recognized, and in the recently published monograph on the subject, R. W. G. Dennis and D. G. O'Brien¹ have made an excellent survey of the information available up to the present time. The rapidity with which knowledge on the subject has accumulated may be judged by the fact that only six years have elapsed since the matter was of purely scientific interest, whereas now it has become one of economic importance. New plants for which boron is essential are constantly being discovered, and this year it has been established at Rothamsted that carrots should be added to the list. According to Bertrand and de Waal², carrot contained 25 mgm. boron per kgm. dry matter compared with 2.3-5 mgm. in cereals and 75.6 mgm. in beet, all plants being grown in the same soil. This relatively low boron content of carrot possibly indicates that its need for the element is not great, and that in consequence, disease due to its deficiency is not likely to be widespread.

K. WARINGTON.

Rothamsted Experimental Station,
Harpenden, Herts.

¹ *West of Scot. Agric. Coll. Res. Bull.*, No. 5 (1937).

² *Ann. Agron.*, 6, 587-641 (1936).

Products formed during the Preparation of Ketene

TRACES of naphthalene have been detected in the acetone condensate obtained during the preparation of ketene by passing acetone vapour over electrolytic copper heated in a silica tube.

The naphthalene was isolated from the acetone condensate by distilling off the acetone and a colourless pungent liquid boiling up to 120° C. The remaining brown tar was steam distilled giving a pale yellow solid which sublimed to colourless crystals, m.p. 79–80° C. These crystals were identified as naphthalene by picrate (m.p. 140–143°; 147°) chlorodinitrobenzene (m.p. 75–76°) and trinitro toluene (m.p. 92–95°) derivatives.

As evidence against the possibility that the naphthalene may have been due to impurities, naphthalene was again detected in similar quantity when extra care had been taken to exclude any such impurities.

It would be interesting to know whether any other investigator has detected such a product.

R. W. HALE.

Fort Dunlop,
Birmingham.
Oct. 22.

Why Do Stranded Whales Die?

WHEN a school of whales was stranded on an Australian coast, much to the discomfiture of local health authorities, I put to various colleagues in the University of Melbourne the simple query: Why do stranded whales die? I received the following answers, and it was amusing to note that in most instances the explanation was coloured by the special study of the colleague interrogated.

(1) The blood now being acted on by gravity collects in the dependent parts and produces anaemia of the brain.

(2) The weight of the body impedes breathing.

(3) Vital organs are crushed by the great weight.

(4) The unaccustomed warmth, especially if there is direct insolation, induces heat stroke.

(5) The unaccustomed temperature interval between night and day gives rise to internal chills and probably pneumonia.

(6) The whales do not die because they are stranded; they are stranded because they are dying.

Perhaps the list can be extended by readers of NATURE.

W. A. OSBORNE.

University, Melbourne.
Nov. 1.

Points from Foregoing Letters

A COMPLETE skull of *Sinanthropus pekinensis* (female) has been reconstructed by Prof. Franz Weidenreich by means of a recently discovered upper jaw with six teeth together with other fragments of the facial skeleton previously found, belonging to the same species, so that all the essential parts are based on actual findings. Photographs are submitted showing a comparison of the reconstructed skull with that of a female gorilla and an adult male Chinese.

X-ray photographs obtained by Dr. A. Müller from nickel and gold disks under high-dispersion conditions (using the β -line of iron and the α_1 -line of nickel, respectively, as incident radiations) show that the X-rays are scattered over a comparatively wide range. The author concludes that precision data on lattice dimensions have to be regarded as statistical averages of figures varying within, say, 1/1,000. The lattice 'constant' of an individual crystal is less reproducible than that of the average.

An X-ray study of iron-nickel-aluminium alloys has led Dr. A. J. Bradley and A. Taylor to put forward a new explanation of the properties which enable them to be used as permanent magnets. On slow cooling, these materials break up into two body-centred cubic lattices of widely varying compositions, but in the permanent magnetic state the two lattices remain coherent.

Prof. R. Ruggles Gates submits photomicrographs showing that anaphase chromosomes of *Trillium sessile* are double. The demonstration of this fact has important consequences for hypotheses of chromosome structure and behaviour.

Cases of blindness in fish (rainbow trout) are reported by Dr. W. Rushton, due to the presence in the eye lens of the larvae of the trematode, *Diplostomum voluans*. The life-history of this parasite indicates that part of its existence is spent in the gut of water birds.

A plankton collector suitable for towing at a relatively high speed is described by E. Lowe Pierce. It consists of a metal cylinder with cones at each end and an internal conical silk net, the whole being attached to a diving fin.

According to new experiments by Prof. J. O. Wilhelm, H. E. Jones and Prof. Grayson Smith, reported by Prof. E. F. Burton, the refractive index of liquid helium I at 4.22° K. is 1.0206 and at 2.26° K. it is 1.0269. The latter value is identical with that for liquid helium II at a temperature of 2.18° K. when it has the same density. There is no abrupt change in refractive index at the transition point.

The natural activator of papain has been separated from the enzyme system of the latex of the papaw by Prof. Max Frankel and R. Maimin. Its chemical properties and influence on gelatin and peptone cleavage respectively make it probable that this activator is glutathione.

The unequal development of bacterial cultures grown on 'potato slopes' from different varieties of potatoes is described by D. Ward Cutler and Mabel Dunkley. Experiments with *Flavobacterium* indicate that the varieties 'Majestic', 'Epicure', 'Red King' and 'King Edward' give the best results.

"Does an arrow rotate?" inquires L. J. D. Richardson, who points out that the Latin word *torques* may have implied the imparting of an axial spin.

Miss K. Warington directs attention to the growing list of plants for which boron is an essential constituent. The latest addition to the list is the carrot, though its relatively small boron content (25 mgm. per kgm. of dry weight) indicates that disease due to boron deficiency is likely to be rare in this plant.

Research Items

Crystalline Preparations of Viruses

Two papers which describe the preparation and properties of liquid crystalline substances from virus-infected cucumber and tobacco plants have recently been published by Messrs. F. C. Bawden and N. W. Pirie. The first (*Proc. Roy. Soc., B*, 123, No. 832, 274-320; Aug. 1937) shows that such substances cannot be isolated from healthy plants and that crystalline preparations of tobacco mosaic are infective at a dilution of 1 in 10^{10} . Many physical properties of virus mixtures are discussed, and it is interesting to note that filters which pass an infectious filtrate from plant juice will not allow the passage of purified preparations, thus suggesting that the purified aggregates are larger than those which occur naturally in the plant. The other paper (*Brit. J. Exp. Path.*, 18, 275; 1937) considers the relationships between crystalline preparations of cucumber viruses 3 and 4, and strains of tobacco mosaic virus. All such preparations have similar chemical composition, and have many physical properties in common. Precipitation tests and X-ray measurements, however, can distinguish between the cucumber viruses and tobacco mosaic preparations. A reasonable similarity between the chemical and physical properties of a crystalline virus preparation and its pathological behaviour is noticeable.

Invertebrates of Dybø Fjord

DR. KNUD LARSEN's paper "The Distribution of the Invertebrates of the Dybø Fjord, their Biology and their Importance as Fish Food" (Report of the Danish Biological Station 41; 1937) is an attempt to link up the number of animals found on the sea bottom with the numbers eaten by the fishes on the same grounds. The *Macoma balthica* community is specially studied for this purpose. The work is in three sections, dealing with (1) the composition of the animal community; (2) the biology of the individual species, and (3) the importance of the species in the diet of the fishes in the fjord. By means of the first and second sections, the author can calculate the proportion between the percentage quantities of the individual species on the sea bottom and in the fish stomachs. *Idothea viridis*, the commonest isopod of the fjord, comes first in numbers as fish food, being eaten by all the fishes investigated (7), except the roach. Next comes *Gammarus locusta* and the third *Leander adspereus*. The roach is entirely a mollusc-feeder and its extremely rapid growth is attributed to its diet, for molluscs are of high nutritive value. *Mytilus edulis*, *Cardium exiguum*, *Hydrobia* sp. (called here *ulva*), *Littorina rudis*, *Neritina fluviatilis* and *Limnaea ovata* are all eaten. There is a great preponderance of molluscs in the community which make up about 88 per cent of the average weight per square metre, the remaining 12 per cent consisting of crustaceans, worms and insects. It is interesting to find that the *Hydrobia* of the fjord, still unnamed, although placed under the heading of *H. ulva*, has no pelagic larval stage, "the whole development taking place in the egg from which the animal enters the bottom stage directly". This suggests that it is another species and not the true *H. ulva*.

Fossil Insects from the Permian Rocks of Kansas

THE *American Journal of Science*, 33, 81-110 (1937), contains a paper by the late Dr. R. J. Tillyard which forms Part 17 of that author's series on Kansas Permian insects. Under the name of *Elmoa triecta*, there is described what is claimed to be the first known Megasecopteran from these rocks, the author not accepting the view that the contemporaneous Protohymenoptera are specialized members of the same order. The new genus *Kansasia* is erected for the third known Palædipteron from the same beds. An apical fragment 8 mm. long of an early dragonfly wing is named *Cumplotaxineura* and made the type of a new family of Protanisoptera. In the new family Permambiidae there is brought to light what is described as an early group of Psocid affinities. The remainder of the paper deals with Neuropterous fossils and adds considerably to knowledge of that order in Lower Permian times. Most of these appear to be allied to the recent family Berothidae, of which archaic living types still remain in Australia. The basal half of a wing of Sialoid affinities is named *Promartynovia* as the type of a new family of ancient alderflies. It is pointed out that the relationships of these early Sialioidea are obscure, and better material is needed before they will be understood.

Embryology of the Crustacean *Anaspides*

In *Papers and Proceedings of the Royal Society of Tasmania* for 1936 (1937; pp. 1-35, pls. i-xiii), Mr. V. V. Hickman contributes an important article on the embryological development of *Anaspides tasmanica*. It forms the first account yet published of the development of any of the Synocarida. *Anaspides*, it appears, shows, in its development, a close resemblance to the Leptostraca as exemplified by *Nebalia*. The early stages, however, bear some resemblance to those of certain of the Entomostraca. Thus the holoblastic segmentation, followed by the formation of an evident blastocoele and the development of an invagination-gastrula giving rise directly to the mesenteron, are cases in point. In certain other respects, *Anaspides* also resembles the Branchiopoda. These are evidenced in the mode of origin of the maxillary gland, the long persistence of yolk granules, the prolonged dormancy of the embryo in the winter egg and in the mode of hatching. A further resemblance is seen in the habit of movement in an inverted position (when young) on the underside of the surface film in calm water. The author states that it is hoped to supplement this paper by further examination of the post-embryonic development.

Herbage and Forage Seeds

THE last three bulletins of the series of six on the production of seed of herbage and forage crops have now been published by the Imperial Bureau of Plant Genetics (Herbage Plants), Aberystwyth. Bulletin 22 (price 5s.), by Gwilym Evans, describes the technique which has been evolved at the Welsh Plant Breeding Station for producing seed from their various strains of hay and pasture grasses, special consideration being given to the time and rate of sowing, isolation, manures and fertilizers,

harvesting, seed conditioning and storing. Bulletin 23 (price 5s.), edited by R. O. Whyte, is concerned with the methods used in the production of legume seed (lucerne, various clovers, etc.) in different parts of the world, and is a companion volume to Bulletin 19, already published, which deals with the production of grass seed from a similar point of view. Bulletin 24 (price 2s.), by F. J. Crider and M. M. Hoover, gives an account of the collection of native grass seed in the Great Plains, United States, and will be of particular interest to those in the more arid grassland countries where erosion is a problem, as it contains illustrations of typical grasses which are being produced in connexion with the soil conservation programme of the Great Plains district.

Arctic and Antarctic Diatom Floras

THE report on the diatoms collected during the Australasian Antarctic Expedition, 1911-14 (Scientific Reports. Series C. Vol. 1, part 1. Pp. 82+6 plates. Washington: U.S. National Museum. 9s.) emphasizes the wealth of the diatom flora of the arctic and antarctic areas. Dr. Mann suggests that the high percentage of carbonic acid held in solution owing to the low temperature and the long-continued light during the summer season may be significant in this connexion. In contrasting the two areas, the striking difference is that the arctic species are small and relatively simple in construction, whilst the antarctic forms are large and elegant in form and ornamentation and include many forms common to temperate and subtropical seas. Dr. Mann points out that owing to the distribution of the land masses, wide open seas run down to the antarctic and include various southerly currents, whilst the arctic seas are more enclosed by land masses and even in the Atlantic, the only northward current is that running along Scandinavia towards Spitsbergen. The species recorded are listed and described.

Incompatibility and Sterility in Sweet Cherries

THE results of an exhaustive survey of cherry varieties in respect to the above properties have recently been presented by M. B. Crane and A. G. Brown (*J. Pom. and Hort. Sci.*, 15, 2, 86; 1937). Conclusions drawn from more than 236,000 pollinations are discussed and the results presented in tables which should prove of great value to the cherry grower. Incompatibility in the sweet cherry is due to the failure of the pollen tubes to complete their growth down the tissue of the style, with the result that fertilization cannot take place and the young 'fruit' ceases growth and falls from the tree at an early stage. This is distinguished from sterility, which is expressed by non-viable pollen or imperfectly developed ovules, being more apparent on the female than the male side. Incompatibility is determined by genetic factors which control pollen-tube growth, and it seems that under normal conditions pollen cannot function in the style of a plant carrying the same factors as the pollen. All the varieties examined exhibited self-incompatibility without exception, whilst cross-incompatibility was common and always reciprocally expressed. The yields from compatible crosses showed considerable variation, which though largely due to indirect factors such as age of tree and previous cropping, was undoubtedly due in certain cases to the effect of generational sterility on the proportion of fruits which set and reached maturity. The genetical aspects of the results are discussed and

the practical applications indicated. Though many factors such as disease, nutrition, climate, etc., affect the initial setting of the fruit and the ultimate yield, it is clear that effective pollination and fertilization are essential. In view of the general occurrence of self-incompatibility and the frequency of cross-incompatibility, no variety of sweet cherry should be planted in complete isolation either as single trees in private gardens or as large blocks in commercial plantations. Care should be taken to inter-plant varieties which are known to be compatible and which flower at the same time.

A New Fungus Gall

THE fungus *Cyttaria septentrionalis* causes the appearance of a gall upon *Fagus Moorei* in southern Australia. It is rather infrequent to find that an operculate member of the Pezizales has such an action upon a living tree, and the structure of galls formed by this fungus has been investigated by Miss Janet M. Wilson (*Proc. Linn. Soc. N.S. Wales*, 62, Pts. 1-2; 1937). Wedge-shaped areas of infection appear on the small branches, and although the galls may grow to a considerable size, they do not appear to restrict the growth of that part of the tree upon which they occur. Secondary xylem and phloem, cambium and cortex are all invaded by mycelium of the fungus, and each region is enlarged by the abnormal multiplication of cells. Haustoria of the fungus approach the nucleus of a living cell in the host, and coil around it, but do not cause death. Initial infection appears to be associated with the cambium, and the fungus often lies dormant for a season, before it initiates the formation of a gall.

Ecology of Tomato 'Spotted Wilt' Virus

A VERY extensive study of the incidence of 'spotted wilt' disease in field plots of tomatoes in southern Australia has been made by Dr. J. G. Bald (*Bull. Council for Sci. and Ind. Research*, No. 106, Melbourne, 1937). Records of infection were made for nine years, and yielded a number of interesting results. The degree of infection rose through the growing period in a series of successive maxima which apparently represented the emergence of successive broods of the transmitting insects *Thrips tabaci* and *Frankliniella insularis*. High temperatures usually increased the rate of infection, and within a range of about 15 yards from a source of infection every plant had an equal chance of contracting the disease. It required isolation by distances of 200-300 yards before the spread of infection was seriously reduced. Migration of thrips from overcrowded populations upon plants of *Solanum nigrum* and *Lycium ferocissimum* also accounted for considerable infection in spring, and it was possible in all cases to find a positive correlation between the degree of infection and the relative number of transmitting insects.

Structural Geology of Maryland

VOL. 13 of the reports of the Maryland Geological Survey is of general interest to geologists because it contains a detailed account of the methods used in investigating the structures of crystalline rocks and a fine series of examples of the application of these methods. Hitherto, much of the more recent relevant literature has been in German. The Piedmont Province of Maryland includes complexes of igneous rocks which were intruded as molten masses into

rocks already metamorphosed. Both were then again subjected to forces which further transformed them. Ernst Cloos shows how the various types of rock behave under stress and summarizes the methods by means of which the available evidence can be pieced together to yield a picture of the former conditions and history of the region. H. G. Hershey gives an account of the structure and age of the Port Deposit Granodiorite complex. The ovoidal gneiss-domes near Baltimore are shown by C. H. Broedel to have originated as a result of earth movements which began in Pre-Cambrian time. A volcanic complex in Cecil County has been studied by J. Marshall. The history is one of isoclinal folding, fracture cleavage, intrusion of gabbro, injection of granodiorite followed by dykes and veins, and finally development of cataclastic structures along shear zones. The statement in the preface that "The volcanic activity is the oldest geological incident in the history of this region since the lavas include fragments of all subsequent rocks formed prior to the close of igneous activity after the invasion of the gabbros and granites which now form the rocks of the Susquehanna Gorge" is not very helpful. The Baltimore Gabbro consolidated as a saucer-like body between adjoining domes of Baltimore Gneiss. Made classic by the well-known work of Williams half a century ago, it has now been thoroughly re-studied by C. J. Cohen. Primary flow-lines are distinguished from superposed structures due to subsequent deformations. The volume also contains an account of the Upper Cretaceous stratigraphy of the coastal plain of Cecil County by C. W. Carter.

Sanriku Earthquake Seawaves of 1936

IN 1896 and 1933, and to a less extent in 1897, the north-east coast of Japan suffered from the seawaves resulting from great earthquakes. On November 3, 1936, an earthquake, strong enough, like the others, to cause slight damage on the adjoining coast, occurred in the same region of the Pacific. Mr. N. Miyabe (*Bull. Earthq. Res. Inst.*, 15, 837-844; 1937) has described the small seawaves, about one foot in range, that were recorded at seven stations on the Japanese coast. The interval between the time of occurrence at the origin of the earthquake and the first disturbance on the mareogram, ranging from 28 min. to little more than an hour, enabled him to estimate the distances of the origin from six of the stations, and thus to obtain the position of the epicentre in lat. $38^{\circ}0'$ N., long. $143^{\circ}0'$ E. It is interesting to notice that all four epicentres lie on a curve roughly parallel to the coast, about 90 miles in length and the same distance from the coast and coinciding nearly with the isobath of 3000 metres, the epicentre of the latest earthquake occupying the most southerly position.

Crystalline Vitamin A

ALTHOUGH the existence of vitamin A was proved so early as 1913, its isolation is only very recent, and a provisional standard based on the extinction coefficient of a concentrate has been in use. H. N. Holmes and R. E. Corbet (*J. Amer. Chem. Soc.*, 59, 2042; 1937) now describe the preparation of a substance crystallizing in pale yellow needles, melting at $7.5-8.0^{\circ}$, and having the very high extinction coefficient of 2100, as compared with the highest previous value of 1700 and the provisional standard of 1600. The substance is regarded as pure vitamin A. It was obtained from the liver oils of three different

species of fish by a process of fractional freezing and cold filtration, and the addition of water to a solution in methyl alcohol. The biological assays give about 3 million international units per gram. The molecular weight by freezing point lowering was found to be 294, whilst Karrer's formula, $C_{28}H_{44}O$, for vitamin A requires 286. It was found that extinction measurements with the spectrophotometer should be made instantly after dilution with ethyl alcohol, since the extinction coefficient changes rapidly on standing and indications of a new absorption band appear, perhaps as a result of chemical change. The combustion analyses of the substance gave C = 83.28, H = 10.44, whilst Karrer's formula requires C = 83.84 and H = 10.56 per cent.

Liquid Parahydrogen

THE molecular volumes at saturation of liquid normal hydrogen and parahydrogen have been determined by R. B. Scott and F. G. Brickwedde (*J. Research Nat. Bur. of Standards*, 19, 237; 1937), who find that parahydrogen has a higher molecular volume, the expansivity being only slightly greater than that of normal hydrogen. The change in molecular volume in passing from orthohydrogen (molecules rotating) to parahydrogen (molecules not rotating) is opposite in direction to the change observed with other substances in passing from rotating to non-rotating states. An explanation is given based on the small moment of inertia of the hydrogen molecule so that the orientation of the axes of the molecules of parahydrogen can have a random distribution in the liquid and solid phases, and hence the state of non-rotating parahydrogen is like that at high temperatures in other substances whose molecules are rotating. The discussion involves a detailed consideration of the intermolecular forces for the two kinds of hydrogen molecule, the repulsive forces arising from regions of high electron density in neighbouring molecules being different. It may be mentioned that E. A. Long and O. L. I. Brown (*J. Amer. Chem. Soc.*, 59, 1922; 1937) find no essential difference in the p, v, t relations of normal and parahydrogen gases at low pressures from the boiling point to 55° K.

Conductance of Mixtures of Strong Electrolytes

ALTHOUGH the simple theory of Kohlrausch indicates that the electrical conductance of a mixture of strong electrolytes is additively composed of the separate ionic mobilities, calculations by Onsager and Fuoss based on the modern theory of electrolytes indicate that the decrease in velocity of an ion due to the field effect is a function of the properties of all the ions in solution, and a deviation from the additive law is to be expected. Experimental results found by Bray and Hunt in 1911 showed good agreement between observed and calculated values at low concentrations, but at higher concentrations the observed mixture effect appeared to be about half that calculated. In these experiments, mixtures of hydrochloric acid and sodium chloride were used. K. A. Krieger and M. Kilpatrick (*J. Amer. Chem. Soc.*, 59, 1878; 1937) have now investigated mixtures of lithium and potassium chlorides. The same result is found, namely, that the observed change is about half that calculated by Onsager and Fuoss at higher concentrations and tends to agree with it at lower concentrations. No explanation of the discrepancy is offered.

History of Science and Technology

FOURTH INTERNATIONAL CONGRESS

THE fourth International Congress of the History of Science and Technology was held in Prague on September 22-27 under the presidency of Prof. Quido Vetter. A few days prior to the Congress, Czechoslovakia had been struck a cruel blow by the death of the President-Liberator of the Czechoslovakian Republic, Dr. T. G. Masaryk. The delegates to the Congress assembled on the day of the funeral, and as was to be expected at such a time of national mourning, the Congress opened under a cloud of sadness. The social functions previously announced did not take place, but otherwise the whole programme of work was completed.

The conference, which was most successful, was attended by about two hundred and fifty members, including a distinguished group of Czechoslovakian scholars and scientific workers, as well as by delegates from twenty-four other countries. Official delegates had been sent by the Governments of the Argentine, Austria, Bulgaria, Great Britain, Italy, Latvia, Mexico, Rumania, Spain, Sweden, Switzerland and the United States, while the leading foreign academies of science, scientific societies and universities were also represented. The absence of representatives from Germany, however, was noticeable.

The meeting coincided with the one hundred and fiftieth anniversary of the birth of J. E. Purkyně, the famous Czechoslovak biologist, and delegates were invited to take part in the international celebration and conference which had been arranged by the Purkyně Society to commemorate the occasion. A visit was also made to the tomb of Purkyně at Vyšehrad. It had previously been recommended to the International Academy that the Congress should deal with the development of sciences in the eighteenth century and in the first half of the nineteenth century, while as a second subject the "History of Science in Instruction" was proposed.

The opening session of the Congress was held in the well-appointed Purkyně Hall of the Institute of Medicine, at the University of Charles IV, under the presidency of Prof. Q. Vetter, president of the Congress. The delegates were welcomed on behalf of the Czechoslovakian Government by Dr. E. Franke, Minister of Public Instruction. Prof. Charles Singer, who led the British delegation, communicated friendly greetings and good wishes from Great Britain for the success of the conference, and similar messages of good will were expressed by several other foreign delegates. The inaugural address was then given by Prof. Boh. Němec on the subject "From Newton to Darwin".

On the following day an address on "The Spirit of Science in History" was given by Prof. Singer before one of the plenary sessions of the Congress. He pointed out that the ultimate aim of the scientific mood—as of the other great moods, the religious and the artistic—is to integrate the outer with the inner world. He emphasized that the scientific mood must demand independence of all the other judgments that influence mankind, such as those based on fashion, tradition, taste, nationality or class, and

showed that science is of all studies the most truly man-wide, humane and international.

Prof. G. Loria of Genoa gave an interesting account of a study of the geometric representation of values in the different epochs in the history of mathematics, and indicated the conclusions he had deduced from these researches. Dr. Joseph Mayer of Washington directed attention to the reasons why the social sciences lag behind the physical and biological sciences, which have moved forward with unprecedented rapidity during the last hundred to hundred and fifty years. He showed that, at any rate in the light of the history of science, we can at least understand why there is so much uncertainty, hesitation and apparent misunderstanding in contemporary efforts to solve social problems. Other addresses given before the plenary sessions included "The Biological Cosmologies of the Nineteenth Century" by Prof. Otto Grosser, "The Development of Agriculture in Czechoslovakia" by Dr. F. Lom, "The Beginning of Scientific Life among the Rumanians" by Prof. Valeriu Bologa, "Purkyně and the Cellular Theory" by Prof. F. K. Studnička.

The work of the Congress itself was divided into six main sections, namely, (a) general science, (b) mathematics, (c) natural science, (d) medicine, (e) agriculture, (f) technical science. Approximately one hundred and fifty papers, which covered an extremely wide range of subjects, were scheduled for presentation and discussion at these meetings. A memorial meeting was held on the occasion of the one hundred and fiftieth anniversary of the birth of J. E. Purkyně, under the aegis of the Purkyně Society, in the Pantheon of the National Museum on Saturday, September 25, when representatives of universities and scientific societies commemorated the genius of that eminent man of science. The Minister of Education, Dr. Emil Franke, addressed the meeting on behalf of the Czechoslovak Government, and Prof. B. Němec gave an appreciation of Purkyně's work.

The success of the Congress was assured by the cordial hospitality extended to the delegates by the people of Czechoslovakia, and by the well-organized arrangements made by the committee. The delegates were able to visit the many historical buildings and monuments with which Prague is so richly endowed, and were privileged also to inspect the library of the monastery of Prémonstrats at Strahov. Excursions were also made to Karlstein, Křivoklát, Blatná and Strakonice.

A special exhibition of documents relating to the "History of Science in Czechoslovakia" was arranged in the Clementinum, and in the National Museum by the organizing committee with the co-operation of the National Museum, the National Library and the University, while a catalogue of the exhibits was specially prepared for distribution to the members of the Congress. An exhibition of documents and personal relics relating to J. E. Purkyně was also arranged by the Purkyně Society. Another exhibition, of modern scientific and technical literature in Czechoslovakia, was specially arranged, and attracted much attention.

At the opening ceremony of the exhibition in the Clementinum, the delegates enjoyed a performance to ancient Bohemian polyphonus music sung by the Bohemian madrigalists conducted by Prof. B. Špidra. This improvised concert deeply impressed the visitors, as also did the compositions of Rejcha and Mozart played in the large hall of the Wallenstein Palace by the Prague brass quintette. The performance of Weber's "Oberon" in the Prague German Theatre, and that of Smetana's "Libuše" in the National Theatre, as well as the concert of the Czech Philharmonic Orchestra at the Smetana Hall conducted by Mr. Rafael Kubelik, offered further opportunities for the delegates to

become acquainted with the cultural life of Czechoslovakia.

Among the resolutions submitted and approved at the final meeting of the Congress was a proposal that history of science should be included in the teaching of secondary and high schools, and also a request for the publication of Isaac Newton's correspondence.

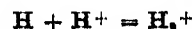
An invitation from the Swiss Government to hold the next congress at Lausanne in 1940 was accepted, and Prof. Arnold Raymond, formerly rector of the University of Lausanne, was elected president. An invitation from the Brazilian Government to an extraordinary congress in 1938 was also accepted.

Overvoltage in Light and Heavy Water

BY means of the polarographic method with a dropping mercury cathode, Prof. J. Heyrovský, in collaboration with Dr. J. Novák, has been able to advance knowledge of hydrogen overvoltage (*Coll. Czechoslovak Chem. Com.*, 9, 207, 273 and 344; 1937). By this delicate method they were able to register significant differences in current voltage curves in light and heavy water, with special reference to hydrogen overvoltage. They find that in 0.001 *N* hydrochloric acid in ordinary water at 20° C. the overvoltage differs from that in 99.6 per cent deuterium oxide by +87 millivolts; in 94.6 per cent D₂O by 63 millivolts; in 76.5 per cent D₂O by 31 mv. and in 49.8 per cent D₂O by 15 mv. At 60° C. the differences with the purest heavy water is +71 millivolts. The factor *b* in Tafel's term, *b* log *i*, is 113 millivolts at 20° C. in heavy water and 102 in light water.

The electro-reduction of hydrogen peroxide is similarly inhibited in heavy water. On the other hand, the electro-reduction of oxygen, and of maleic acid in acetic acid solution, and the electro-deposition of thallous ions in heavy water proceed at an unchanged potential or at a distinctly more positive one than in light water. The theoretical significance of these experimental results is discussed by Prof. Heyrovský, who gives a general theory of hydrogen overvoltage which appears to account well for the observed facts. He regards the electro-deposition of the isotopic

hydrions as indifferent, but the evolution of hydrogen, including its molalization, as 5.4 times less in heavy water; 5.4 is the ratio of the ionic products of H₂O and D₂O, and signifies that the rate of dissociation of water is 5.4 times that of deuterium oxide. The molalization takes place through the interaction of the deposited hydrogen atoms with the hydrions of the solution:



The formula finally deduced for the overvoltage is

$$\pi = + \frac{RT}{F} \log \frac{([\text{H}^+] + [\text{D}^+])^2}{i + \bar{\omega} i^2} (\text{CH}_2\text{OK}_1 + \text{CHOD} (K_1' + K_2') + \text{CD}_2\text{OK}_2),$$

where $\bar{\omega}$ is the mean adsorption coefficient of the freshly formed hydrogen molecules, CH₂O, CHOD and CD₂O denote the molar fractions of the solvent, and K₁ (K₁' + K₂') and K₂ are the dissociation constants of H₂O, HOD and D₂O respectively.

The validity of the equation has been tested by substituting calculated quantities of light and heavy water, and the observed results are in good agreement with theoretical requirements. The electrolytic separation coefficient for the hydrogen isotopes at cathodes with large overvoltage is dependent on the composition of the mixture and on the current density. The mean value of 5.4 should increase to 60 in concentrated heavy water and decrease to 2.7 in ordinary water.

Employment of University Graduates

YEAR by year some 15,000 students enter the universities of Great Britain. Their intentions, hopes and aspirations and those of their parents and other counsellors are almost as various as their pedigrees, but they are admitted on the assumption that their undergraduate years are to be dedicated more or less to preparation for their life's work, and the shaping of university policies is to a large extent determined by that ideal. In their careers after the completion of their undergraduate courses,

the value of that preparation is tested, and the employment of graduates is, obviously, a matter of concern not only to them but also to university administrators and to the community as a whole.

The University Grants Committee in its quinquennial report published last year dealt at considerable length with problems of student numbers and employment. This year the National Union of Students held a Congress at Southampton on April 1-8, at which these formed the main subject of

discussion, the actual title given to the Congress being "Training for What?" The subject was chosen after a serious and sustained effort on the part of the National Union (in association with local unions) to elucidate some of these problems—an effort frustrated to some extent by want of statistics.

For the university statistician, a student ceases to exist from the moment when he ceases to be an active member of the university, and in the absence of authentic statistical data, only conjectural, vague or partial answers can be obtained to such questions as: How many graduates, with what qualifications, were seeking employment twelve months after leaving the university? How many specially prepared for certain vocations have accepted employment in other fields?

This matter of the lack of official statistics of employment of graduates was repeatedly mentioned in the University Grants Committee's report, but without any indication that the Committee thought anybody ought to do anything about it. The Congress report stresses the importance of a comprehensive knowledge of the actual facts about graduate employment, and takes the view that it is 'up to' the universities to acquaint themselves with the practical results of their methods of undergraduate education. Foremost among the topics dealt with by one of the three sections of the Congress, the Commerce and Industry section, was "the work and functions of a university appointments board", the pressing importance of which had been emphasized last year by the University Grants Committee. The results of the discussion of this topic were formulated as a series of definite recommendations, now published in an appendix to the report, including one to the effect that every university appointments board should be charged with the duty of obtaining information about the employment (including unemployment and mis-employment) of graduates, and tabulating it in standardized forms.

It is worth noting that in the case of the University of Wales, the matter is somewhat simplified by the fact that every graduate is, by virtue of graduation, a member of the Guild of Graduates of the University. A valuable report by the secretary of the Guild on "Graduate Unemployment in Wales", published as Appendix D to the Congress report, shows that the Guild's standing committee is a resourceful and influential body. The report is based mainly on replies to 2,250 questionnaires distributed last November. The fact that only 60 per cent were answered suggests that something more compelling than membership of a guild is needed.

So much for statistics. The Congress discussions ranged over many other important matters, among them being the prospects of increased employment of graduates in primary schools and in the local government services.

As pointed out in an article in *The Times Educational Supplement* of September 4 on "Openings for Graduates", the primary schools present a field of service second to none in national importance. The rapid expansion of staff requirements for secondary schools since 1902 has had a most unfortunate result as regards the staffing of the elementary schools. The idea of attracting recruits for these schools from among university graduates was allowed to lapse and a cleavage of type between the teachers in the elementary and those in the secondary and 'public' schools became firmly established. The graduates who now find their way into elementary schools do

so, in general, with reluctance, having failed to obtain employment in secondary schools (for which their training was designed to fit them) and are liable to be regarded with disfavour by their co-workers on that account. Some approach towards unification of conditions of service in the elementary and secondary schools suggests itself as a promising first step towards remedying this unfortunate state of affairs, and one of the Congress resolutions proposed that the Onslow Committee in its investigations into salary scales should be urged to remedy the more glaring inequalities.

The situation is aggravated by the fact that many of the students in the teacher-training departments not merely dislike the idea of teaching in elementary schools but do not really wish to teach at all. "Many of them," says the report, "had obtained a Board of Education grant because it was the only way by which they could obtain the benefits of a university education, while others had drifted into teaching through the absence of any apparent alternative". While lamenting this result of the Board's system of grants, affecting both elementary and secondary schools, it is well to remember that dissatisfaction with one's work is a complaint by no means peculiar to the teaching profession—or to the present age (Horace satirized it). The Education section of the Congress suggested as a remedy "the institution of a greatly increased number of scholarships or grants which, while they would still cater for the needs of the poor student, would not bind the holder in advance to the pursuit of any particular career".

As regards the recruitment of graduates for the local government services, it is perfectly clear that local authorities are proof against persuasion in the form of impressively worded recommendations supported by apparently flawless arguments such as are to be found in the final report of the Royal Commission on Local Government, the report of the Hadow Departmental Committee on Qualifications, Recruitment, Training and Promotion of Local Government Officers, and the reports of the University Grants Committee. Mr. Chuter Ede, chairman of the Surrey County Council, addressed the Professions and Public Services section of the Congress on this subject. He suggested one-year post-graduate courses in the principles and practices of local government, and that the universities should agitate for the institution of competitive examination for appointments to local government service. Discussion of these and other suggestions led to the adoption of resolutions that the N.U.S. should consider co-operation with professional associations such as the National Association of Local Government Officers and that university authorities should be approached in the matter of courses of training for the public services including courses open to persons already in local government service. It had transpired in the course of discussion that in London and Liverpool time is allowed to local government employees for attendance on university courses, and it was thought that in the general adoption of such an arrangement was to be found a hopeful line of approach to the desired liaison between universities and local authorities in relation to appointments. Sir Richard Livingstone's plea, in his address on September 6 to Section I. of the British Association, for adult education of a new type, should help to speed such a movement.

The ever-growing complexity of the modern world is continually throwing up new opportunities for the

employment of trained intelligence. The report takes the view that university students are too prone to ignore all avenues to worthwhile occupations other than the beaten paths of teaching, medicine, engineering, law, civil service, the church and set courses in industry and commerce. "Arts graduates, especially, rarely think of any possible occupation other than teaching". Such considerations point to the need for more recourse to vocational guidance. A first-year course on careers, available for all students, was advocated in an address by Prof. J. H. Jones of the University of Leeds. It should aim at "the development of some conception of citizenship and social responsibility" and should be given, *not* by an appointments officer but by a number of persons experienced in their profession and in the life and purpose of a university. It should be voluntary, but time should be allowed from existing first-year courses to enable students in all faculties to attend. The Congress recorded its approval of the introduction of such orientation courses coupled with a recommendation of vocational guidance by 'careers masters' in schools and appointments boards in universities, mutually co-operating.

The question of limitation of entry into universities has an obvious bearing on graduate employment. This prickly subject is touched on in the report somewhat gingerly. Fairly general agreement was reached in discussions in the Commerce and Industry section that universities ought to select from among candidates for admission only those capable of a distinctively university type of education, "an education in which the student is not so much taught as provided with the tools for the acquisition of knowledge and technique", others being referred to suitable institutions providing higher education of a technical character. Presumably such a selection would be made after a brief probationary period of membership in the university. The report recognizes that any recommendation from a student body that there should be any limitation of educational opportunities might be open to misconstruction and abuse, and suggests, therefore, that the whole matter should be inquired into further by a thoroughly competent commission. The matter is certainly one of enormous importance, but it is difficult to imagine the desired reform being effected without infringing the autonomy of the universities.

Engineering Progress in the Navy

IN taking office, for a second term, as president of the North-East Coast Institution of Engineers and Shipbuilders, Prof. C. J. Hawkes delivered an address in which he reviewed some recent history of the engineering branch of the Royal Navy, established by Orders in Council just a hundred years ago. He referred in particular to the period of his own service, dating from 1900, when great difficulties were being encountered with large water-tube boilers of the Belleville type. Small-tube Thornycroft boilers had given good results in H.M.S. *Speedy* in 1893. The decision in 1894 to install Belleville boilers in the 25,000 h.p. cruisers *Powerful* and *Terrible* was a momentous one and raised a storm of protest. The trials were satisfactory and demonstrated the weight-saving advantages, but later performance was disappointing, breakdowns were frequent and leakage was excessive, thus giving point and momentum to the attacks in Parliament and Press. The committee set up to investigate, however, confirmed the advantages and greater suitability of the water-tube as compared with the cylindrical boiler for use in the Navy. Improved methods of construction and the installation of special machinery in the dockyard enabled the Belleville boilers to give good service, but owing to inherent defects, including the long water and steam course of about 170 ft., some irregularity in water circulation and the deformation of tubes by local heating, it ultimately gave place to more modern designs.

In 1904, oil fuel as a supplement to coal was sanctioned, and seven years later it was decided that all new cruisers and battleships should be designed to burn oil only. Although this was a change of great national importance, it aroused none of the violent passions associated with the introduction of the large-tube water-tube boiler. From the engineer-

ing point of view and that of the ship as a fighting unit, oil firing has several important advantages over hand-fired coal for steam raising. As native sources of supply are as yet quite inadequate to meet the needs of the Navy even in time of peace, the position is a difficult one, but so necessary is it that the Admiralty has decided to continue its use for steam raising in the Fleet. The production of oil fuel from coal is therefore being encouraged.

Up to 1900 all warships were propelled by reciprocating steam engines; the T.B.D. *Viper* was the first to have turbines. There were early difficulties in operating turbines at cruising speed and at full speed, but these were so far overcome that in 1905 it was decided that all future warships be fitted with turbine machinery and, in that year, the *Dreadnought*, the first turbine-driven battleship, was laid down. At first turbines were direct-coupled to propeller shafts, but from 1911 gearing was used, resulting in increased propulsive efficiency and reduced fuel consumption per shaft horse-power. The lubrication of multiple-thrust blocks was a constant difficulty and the author quotes a case in which, at a certain speed, the flow was reversed and oil from the thrust-block wells overflowed from the oil boxes situated 10-12 feet above the shaft. A system of forced lubrication was thereupon devised and worked without trouble, but the real solution came with the invention of the Michell thrust-block, which alone has made present-day shaft loads practicable.

Prof. Hawkes gave figures to show the saving of weight and space which has resulted from these and other improvements, the more marked as they are accompanied by greater reliability and durability. Further advances may be looked for, but it must be borne in mind that in naval design there are limitations which do not apply to land practice.

Electrification of the Paris-Orléans and Midi Railways

THE paper read on November 18 by Mr. A. Bachellery at a joint meeting of the Institution of Electrical Engineers with the British Section of the French Society of Civil Engineers, shows that considerable progress has been made with the electrification of some of the French railways since Mr. Bachellery read a previous paper in 1923. At that date, only about 15 miles of the Paris-Orléans railway was operated electrically, and on the Midi railway there were three sections operating on different systems and at different pressures.

In 1934 the two railway systems were formed into a single group, the electrification work being under common direction. The new permanent way equipments are now of the 1,500 volt direct current type. The system covers nearly the whole of the mountain lines in the Pyrenees, including the two trans-Pyrenean routes, where there are gradients of more than 1 in 25. Next year, when the line between Tours and Bordeaux has been completed, electric locomotives will be able to run without interruption from Paris to Irun on the Spanish frontier, a distance of about 500 miles. At present electrification covers 22 per cent of the length of the whole system and handles 50 per cent of the traffic.

In 1936 the consumption of electrical energy for the railways was 470 million kilowatt hours, and this effected a considerable economy in the use of coal. The energy is mainly produced by hydro-electric plants belonging to the railways, but part is drawn from steam plants connected with the railways' high-voltage lines.

In some parts of the line it was necessary to adopt

electrification, as with coal the attainable speed and maximum loads were far too low. It is noteworthy that although the companies have made very successful attempts to improve the power and fuel economy of its express steam locomotives, the electrification still makes steady progress in advance.

The weight of the fast passenger trains on the French railways is going steadily up. They now often weigh about 750 tons. This is due to the continued increase in the construction of metal coaches and the growing demand for comfort. The road transport competition has forced them to raise their speed, and this implies a large increase in tractive power. Whilst the continuous rating of the most modern passenger steam locomotives does not in practice exceed 2,500 h.p. at the drawbar, and it is only with great difficulty that the average fireman can withstand the strain that this represents, the performance of the high-speed electric locomotive is at least 50 per cent greater. This easily gives the required acceleration for heavy passenger trains.

The average economy of coal on the companies' electrified lines is roughly 670 metric tons per mile of route, and this warrants the cost of electrically equipping the permanent way. Recent economic and social changes have tended to increase operating expenses; but this increase is far less in the case of electric traction than with steam traction. This is due to the fact that whilst the price of coal is steadily rising, that of the energy generated in the companies' water-power plants is practically constant. The capital spent on electrification by the Paris-Orléans and Midi companies has proved a good investment.

Drilling Mud

MUD-FLUID is now an important factor in oil-field development, but although it has actually been in use for more than sixty years, comparatively little technical literature is available on the subject. P. Evans and A. Reid, being sensible of this position, and particularly of the essential part now played by mud-fluid in rotary drilling, have compiled a paper (*Trans. Min. and Geol. Inst. India*, 32, December 1936) which has for its theme the investigation of the properties of mud-fluid, its manufacture and testing.

In this paper, which forms a complete volume, are incorporated certain results of experimental work carried out in the Burmah Oil Company's laboratories and also a review of literature consulted by that Company's technical staff during the course of research work.

Mud-fluid is best prepared by the combined methods of jetting and churning, and should be manufactured at a central plant to facilitate distribution where there are many rotary wells. Reconditioning of used mud by means of de-gassing and de-sanding is essential, especially where the cost of new mud is high; this can sometimes be done by chemical methods, though mechanical means are more usually employed. Above all, mud-fluid should be adequately and regularly tested. Specific gravity can be controlled by varying the proportions of solid

and liquid. Viscosity should be determined, and in so doing both 'yield value' and 'mobility' taken into consideration, as the flow of drilling mud is not similar to that of a simple liquid such as water. Specially designed viscometers are suggested for determination of this function. As the mud has to flow at high speed in a very restricted space, the pressure needed to pump it through the circulating system of the well is proportionately high, and lines are indicated on which it might be possible to relate physical properties of the mud to pressures required for pumping them.

Thixotropy has also to be taken into account in assessing the value and efficiency of mud-fluid. This is a property which causes certain muds to set to a jelly-like mass, but to return to a mobile liquid when agitated. The change from liquid to jelly and vice versa may be repeated almost indefinitely. Viscosity measurement of thixotropic substances is complicated, as viscosity increases or decreases according to whether the mud is agitated or disturbed.

Various other properties of mud-fluid are discussed and the whole work liberally illustrated by graphical and other results. The book serves admirably to show the present state of knowledge of this somewhat obscure subject, and to indicate the lines on which future research could most profitably be undertaken.

Science News a Century Ago

The Royal Geographical Society

THE meeting of the Royal Geographical Society held on December 11, 1837, was devoted to communications relative to Australia. Captain Maconochie had sent a paper "On the Soil and on the Natives, at Port Philip"; the Chief Justice, Sir John Jeffcott, in a letter to Sir John Barrow, had described the site chosen for the City of Adelaide, and Captain Vetch spoke "On the Political Geography and Geographical Nomenclature of Australia". Regarding nomenclature, he said, "This is a branch of geography usually left to chance or caprice; and it will not be easy to find any department so left, which has been more abused. Good taste, and even common sense, is concerned in rescuing Australia from a barbarous and nonsensical catalogue of names which nothing but a positive necessity should tolerate. Whenever native names exist, and when these names may have existed for ages, it appears something like sacrilege to disturb or change them; such names, too, are generally significant, and often contain in themselves useful information as to the migration of the human race, and the former connexion which existed between tribes, now far separate."

Outburst of η Argus Observed by Herschel

"TOWARDS the close of his residence at Feldhausen [Sir John] Herschel was fortunate enough to witness one of those singular changes in the aspect of the firmament which occasionally challenge the attention even of the incurious, and excite the deepest wonder of the philosophical observer. Immersed apparently in the Argo nebula is a large star denominated η Argus. When Halley visited St. Helena in 1677, it seemed of the fourth magnitude; but Lacaille in the middle of the following century, and others after him, classed it as of the second. . . . Herschel, on his arrival at Feldhausen, registered the star as a bright second, and had no suspicion of its unusual character until December 16, 1837, when he suddenly perceived it with its light almost tripled. It then far outshone Regel in Orion, and on the 2nd of January following it very nearly matched α Centauri. From that date it declined; but a second and even brighter maximum occurred in April 1843, when Maclear, then director of the Cape Observatory, saw it blaze out with a splendour approaching that of Sirius. In 1863 it had sunk below the fifth magnitude, and in 1869 was barely visible to the naked eye. . . . There is some reason to believe that its variations are included in a cycle of about seventy years. . . ."—(A. M. Clerke's "Popular History of Astronomy.")

The Collège de France

IN its column of Weekly Gossip, the *Athenæum* of December 10 had the following note: "The French Government," says a distinguished foreigner, by way of comment, on our correspondent's letter last week, 'has resolved to create three new professorships at the Collège de France, one to be added to Natural History, for it has been found that since the death of Cuvier the present establishment is insufficient to fully record the progress of the science; and another for the Coptic and Hieroglyphics, the professorship formerly held by Champollion being devoted to general antiquities. The Constitution of the Collège

de France (he observes) does not at all resemble our universities: its object is not to teach the elements of knowledge, but to keep progress with its advance, and to inform the well-informed. It is a noble institution, which we owe to Francis I. There is no similar institution in the world, that I am aware of; it is open to the public, in the most enlarged sense of the words; there is no payment required, no subscription, no obedience to authority, no registration—the doors are always open, and all persons, male and female, may there enter and obtain knowledge. Cuvier's lectures were always attended by many ladies of distinguished rank; and even the lectures of Abel Rémusat, on Chinese literature, were for years attended to by a lady, who made her Chinese book serve as a veil, for the strangeness of the thing excited some surprise and curiosity'."

University Events

CAMBRIDGE.—Prof. E. Cartan, of the University of Paris, has been appointed Rouse Ball lecturer for the year 1937–38.

The Treasurer has received through the Professor of Zoology a gift of £500 for the Experimental Zoology Fund from a benefactor who wishes to remain anonymous. His gifts to the Fund now amount to £1,800, and he has intimated that he hopes to continue his support of the fund.

Prof. M. Siegbahn, of Stockholm, has been appointed Scott lecturer for the year 1938–39.

It is proposed that Dr. W. H. Thorpe and Dr. A. D. Imms, of Christ's College, be appointed delegates to the International Congress for Entomology to be held in Berlin on August 15–20, 1938.

H. C. Gilson, of Trinity College, Dr. F. S. J. Hollick, of St. John's College, J. W. S. Pringle, of King's College, and Dr. S. Smith, of St. Catharine's College, have been appointed University demonstrators in zoology.

The Royal Astronomical Society has appointed Prof. S. Chapman, of Trinity College, chief professor of mathematics in the Imperial College of Science and Technology, London, to be a member of the Committee for Geodesy and Geophysics.

It is recommended that the stipend of the Cavendish professor be £1,400, and that he be paid £200 a year, non-pensionable, for administration as head of the Department of Physics.

LONDON.—The title of emeritus professor of anatomy in the University has been conferred on Prof. Thomas Yeates on his retirement from the S. A. Courtauld chair of anatomy at the Middlesex Hospital Medical School.

OXFORD.—Dr. J. V. Harrison has been elected University lecturer and demonstrator in geology.

An inquiry by the University as to the number of students in receipt of financial assistance from sources other than relations and friends in the year 1936–37 was recently completed. Out of a total of 4,920 students, 2,646,—that is nearly 54 per cent—were in receipt of assistance. School exhibitions (915), local education authorities' grants (862), open scholarships (602), open exhibitions (465), and grants from colleges (326) were the principal forms of the emoluments.

Societies and Academies

Edinburgh

Royal Society of Edinburgh, November 8.

F. A. E. CREW: The sex ratio in the domestic fowl and its bearing upon the sex-linked lethal theory of differential mortality. Among 2,216,051 live-born chicks the percentage of males was 51.38 ± 0.03 . Among 8,565 dead in shell the percentage of males was 51.03 ± 0.54 . These figures do not support the sex-linked lethal theory. There are significant differences in the secondary sex ratio of different 'breeds' and this fact probably explains the differences in the sex ratio reported by different investigators.

N. GALPIN: Factors affecting hatching weight of chickens. Analysis of data show that chicken hatching weight, egg weight, percentage hatching weight of egg weight, and hatchability, tend to decrease as egg production increases. When reproductive activity falls off the above factors increase. From glandular weight, thyroid activity appeared to be highest during months of high egg production. The high thyroid activity has been related to the decrease in hatchability, egg weight, hatching weight, and percentage hatching weight of egg weight.

F. A. E. CREW and S. S. MUNRO: Gynandromorphism and lateral asymmetry in birds. Three new cases of gynandromorphism and five of simple lateral asymmetry are recorded. Critical examination of all reports indicates that autosomal elimination is responsible for simple asymmetry, and autosomal non-disjunction for gynandromorphism and pronounced lateral size asymmetry in the XY or female type, and for pronounced lateral size asymmetry only in the XX or male type.

Paris

Academy of Sciences, October 26 (C.R., 205, 697-760).

JULES DRACH: The reduction of the general equation of Riccati.

PAUL DUBREIL and MME. LOUISE DUBREIL-JACOTIN: The algebraic properties of the relations of equivalence.

ALEXANDRE WEINSTEIN: The spectrum of the equation of the vibrations of framed plates.

MENACHEM SCHIFFER: A calculus of variation for a family of univalent functions.

FERNAND AIMOND: Some properties of surfaces deduced from their mechanical significations.

ALEXANDRE FAVRE: Study of the Toussaint-Caraffi hydrodynamic tunnel with the view of obtaining bidimensional movements. Flow without circulation.

ROBERT SILBER: The definition of unitary coefficients and of the polars of the complete aeroplane.

JEAN DUFAY: Remarks on the diffusion of light in the Milky Way.

HENRI MINOUR: The determination of the distance of the centre of the Milky Way and the constants of the galactic rotation by means of the open clusters.

EMILE SEVIN: The theory of stellar radiation.

JEAN LOUIS DESTOUCHES: The equivalence group of a deductive theory.

JOSEPH BETHENOD: Study of the discharge of a condenser through a gas tube.

MARCEL LEMARCHANDS and WALTER JUDA: Concerning the phenomena of electrolytic overvoltage.

PIERRE GENET: Sodium hydrogen arsenate, NaH_2AsO_4 , and its hydrates.

GEORGES ARRAGON: The structure of two pent-acetylsorbosides.

MME. YVONNE KHOUVINE and YOSHINORI TOMODA: Tagatose and methyltagatoside.

ANDRÉ WAHL and VICTOR LIVOVSKI: The dimethylindoles.

CHARLES DUFRAISSE and JEAN HOUFILLART: Researches on the dissociable organic oxides. The hydrogenation of the photoxides. The results of the hydrogenation of naphthacene, tetraphenylnaphthacene (rubrene), anthracene and mesodiphenylanthracene, with Raney nickel as catalyst, are given, and their meaning discussed.

PAUL RIOU, GÉRARD DELORME and HORMINDAS GAMBELIN: The distribution of manganese and iron in the conifers of Quebec province. Analyses are given of various organs of six species of conifers. In all species, the leaves have the highest proportion of manganese, and an increase in the amount of manganese is accompanied by a reduction in the amount of iron.

AURELIO QUINTANILHA: Contribution to the genetic study of Buller's phenomenon.

JULES ALQUIER and MME. ANDRÉE MICHAUX: The calcium/phosphorus ratio in the cutaneous tissue and in the blood of the rabbit in the course of growth.

VICTOR PLOUVIER: Researches on the stabilization of some plants giving hydrocyanic acid.

CHARLES JOYEUX and JEAN GEORGES BAER: Researches on the evolution of the cestodes of Gallinaceae.

STÉFAN NICOLAU: The genesis of the inclusions produced by ultra-virus in general and by the herpetic virus in particular.

ANDRÉ LWOFF and HISTAKE DUSI: Thiazol, a growth factor for the flagellates *Polytoma caudatum* and *Chilomonas paramecium*.

Cape Town

Royal Society of South Africa, October 20.

W. E. ISAAC: Evolution of a growth inhibiting emanation from ripening peaches and plums. Air passed over certain varieties of ripening peaches and plums was found to exercise a marked effect on seedlings of the broad bean (*Vicia Faba*), sunflower (*Helianthus annuus*), and the Canadian wonder bean (*Phaseolus vulgaris*) and also on sprouting potatoes. The Canadian wonder bean was used for most of the experiments. The effects were: retardation of growth in length, increased growth in thickness due primarily to an increase in the size of the cortical cells, decrease of total amount of growth and changed reaction to gravity. Quantitative evidence was obtained of decrease in total amount of growth. Evidence is presented for regarding ethylene, evolved in very small amounts, as the effective growth inhibitor.

J. L. B. SMITH: A new gobioid fish from South Africa.

I. DONEN: A note on the distribution of chemical compounds in the inner and outer portions of the flesh of the Kelsey plum.

W. PUGH: Complex fluorides of gallium and some heavy metals.

F. G. Cawston: (1) The development of teeth in the radula of fresh water Mollusca. There is a rapid increase in the number of teeth of fresh water Mollusca as soon as the radula is put to use after the animal hatches out. Tricuspid teeth in each row are added to from the marginals whose cusps coalesce as the animal grows. Fresh water species possess broad rows of teeth but not so many as some lagoon and land species. The stoutest teeth are those which are exposed to most use. Some increase in size of individual teeth may be expected during the first few months of the animal's existence. The best illustrations of typical teeth of the various fresh-water molluscs are obtained by preparing camera lucida models. (2) South African larval trematodes with forked tails the life-cycle of which is at present unknown. It is considered important to discover the life-cycle of furcocercous cercariae if the various forms are to be recognized. Difficulty is experienced in the differential staining of cercariae. Notes are given on some South African cercariae.

JOHN HEWITT: Descriptions of new forms of the genus *Acontias* Linn. Five new subspecies are described, preceded by an introductory account dealing with the forms occurring in Africa and their distribution.

W. J. COPENHAGEN: Sulphur as a factor in the corrosion of iron and steel structures in the sea. (2) Sulphides in bottom muds of certain harbours of the world. In a previous paper, reference was made to the occurrence of ferrous sulphide in the corrosion product on the surface of iron and steel vessels and structures when immersed for a period in sea-water. In all cases of bottom muds, except open roadsteads, ferrous sulphide was present in the bottom muds in comparatively higher concentration than that of marine muds on the floor of the ocean. The origin of the ferrous sulphide in bottom muds has been investigated and is of bacterial origin, that is, (a) from decomposition products of waste in harbours, and (b) by the reduction of sulphates in sea-water. Ferrous sulphide under certain conditions is oxidized to ferric oxide and elementary sulphur. The latter rapidly combines with exposed iron (in iron and steel structures) and rapid corrosion of the structures ensues.

Moscow

Academy of Sciences (*C.R.*, 16, No. 3, 1937).

I. M. VINOGRADOV: Some new problems of the theory of primes.

B. SALTUKOV: (1) The solution of the integral equation of N. Moisseiev in the theory of the non-regularized geoid figure. (2) The quasi-Stokes form of the integral equation of N. Moisseiev for the non-regularized geoid.

M. KELDYŠ and M. LAVRENTIEV: The uniqueness of solution of the Neumann problem.

B. FUCHS: The group of analytical movements of invariant geometry with pseudoconformal images.

L. V. KANTOROVICH: The moment problem for a finite interval. (A correction to the note published in *C.R.*, 14, No. 9, p. 531; 1937.)

L. MAGNARADZE: Fundamental problems of the theory of elasticity in two dimensions, for contours with angular points.

I. N. VÉCOVA: A complex representation of the general solution of equations of the stationary flat problem of the elasticity theory.

V. A. GAVRILENKO: Additional considerations regarding the distribution of velocities in turbulent uniform flow.

V. KUPRADZE: The theory of electromagnetic fluctuations in an even non-homogeneous field.

N. K. MIHAL: The determination of plummet deflections from the anomalies in the horizontal gradient of gravity.

A. I. KURENCOV: Fundamental regularities in the distribution of the dendrophilous lepidopterous fauna (Macrolepidoptera) in the Ussuri province.

B. A. ZENKOVIČ: Weighing whales.

E. ANDREJEVA: Ossification of the skeleton of the extremities in embryos of the Kirghizian fat-tail sheep.

A. A. TERENTJEVA: Development of the hairy covering in the Kirghizian fat-tail sheep.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, December 13

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—F. S. Chapman: "Lhasa in 1937".

Wednesday, December 15

GEOLOGICAL SOCIETY OF LONDON.—Prof. R. M. Field: "Geophysical Exploration of Ocean Basins".

Thursday, December 16

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Charles Sherrington, F.R.S.: "Jean Fernel and Astrology" (Thomas Vicary Lecture (2)).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—General Discussion on "Electrical Engineering Education". Introductory papers by Prof. C. L. Fortescue, Col. H. C. Fraser and F. H. Clough.

Friday, December 17

INSTITUTION OF CHEMICAL ENGINEERS (at the Institution of Civil Engineers), at 6.30.—Dr. R. E. Slade: "The Development of Grass Drying" (Annual Public Lecture).*

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

UNIVERSITY DEMONSTRATOR IN MINERALOGY AND PETROLOGY in the University of Cambridge—Dr. F. C. Phillips, Department of Mineralogy and Petrology, Downing Street, Cambridge (December 14).

SCIENTIFIC OFFICERS in the Air Ministry Scientific Research Pool—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. (December 17).

LECTURER IN ELECTRICAL ENGINEERING AND MATHEMATICS in the Aston Technical College, Whitehead Road, Birmingham, 6.—The Principal (December 18).

LECTURER IN MECHANICAL ENGINEERING in the Oxford School of Technology, Art and Commerce—The Chief Education Officer, City Education Office, Oxford (December 20).

JUNIOR ECONOMIST to the Ministry of Agriculture and Fisheries, 19 Whitehall Place, S.W.1.—The Secretary (January 7).

LECTURER IN CHEMISTRY in the Nottingham College of Technology and Art—The Director of Education, Education Office, Nottingham.

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3555

SATURDAY, DECEMBER 18, 1937

Vol. 140

Australia's Burden

IN the early years of the twentieth century, it was generally accepted—in fact it had almost come to be regarded as axiomatic—that the 'backward' races must inevitably die out. The white man's burden—to civilize the savage—was being discharged in a process of elimination. Now, however, owing in part to a stern check on the more questionable 'advantages' of civilization, in part to what may be termed compendiously the anthropological approach in methods of administration, there are populations, comparatively speaking extensive, of which the numbers are more or less decisively increasing. The peoples of the greater part of Africa are an instance in point, while even the Indians of North America, for long quoted as a tragic example of degeneration and decay, seem to have entered definitely on the upward grade. Evidence from many quarters affords no uncertain indication, not merely that degeneration and extinction are by no means inevitable concomitants of the spread of white civilization to the remoter parts of the world, but also that under regulation of cultural contact and with such a degree of provision of medical attention as civilization normally brings in its train, native communities may retain, or even actually improve, their level in the matter of population, both in respect of absolute numbers and of relative increase.

In these circumstances it is, to say the least, remarkable that pessimism should still govern the outlook on the problem of the Australian aborigines. We are told of "tribes dying on their feet"; while a recent writer closes a review of the history and present condition of the Australian blackfellow in relation to white civilization by saying :

"As a good Australian I deplore that we must confess failure in dealing with our native races. We have studied them as museum specimens are

studied, we have had humanitarian suggestions for their betterment, but we have utterly failed to keep them alive. Some outside advice is needed, or in a few years, a very few years, there will be none of these unique stone age people left—they will have gone the way of the vanished Tasmanians, the way of death." (R. H. Croll, "Wide Horizons", Sydney, 1937, p. 143.)

It cannot be denied, even when every allowance is made for the difference in theological and sociopolitical outlook of an earlier day, that the record of Australian civilization in relation to the aborigines is bad. It has been estimated that when white settlement first took place in Australia, the native races numbered three hundred thousand. It is quite possible that this figure is too high ; but it is generally agreed that a little over a hundred years ago they numbered at least one hundred and fifty thousand. Now, a favourable computation places them at about seventy thousand ; and it is probable that the true figure is nearer sixty thousand. One estimate is as low as forty thousand.

Impressive as are these figures, they gain in significance when viewed in relation to the desolation of the abandoned occupation sites on former aboriginal lands, and when interpreted in terms of the complete extermination of those tribes of south-eastern Australia which a little more than a generation ago afforded the anthropologist the evidence, now priceless, of the most primitive form of human society then known among living races—evidence which—would be of inestimable value could it now be tested in the field in the light of modern methods of inquiry.

All this, however, belongs to the past ; and it little profits to recall it, except in so far as it is a measure of Australia's debt to the aborigines, and to stress the necessity of a change of heart towards

present conditions, while pointing the way to measures of adjustment in the future. Not indeed that it is intended to suggest here that the Australian people is callous in its attitude towards the blackfellow. There is a growing recognition among individuals that the case of the aboriginal demands a 'fair deal'; and on more than one occasion a wave of public indignation has demanded that his rights should be respected and that he should be adequately protected from the effects and encroachments of white civilization.

Some years ago, not long after the Great War, the late Dr. Herbert Basedow, while on a scientific expedition to Central Australia, was aroused to indignation by conditions among the aborigines; and on his return to Adelaide, he stimulated public feeling to a degree which forced the Government to add a large tract of land to the aboriginal reserves in the centre of the continent to provide them with land adequate for the subsistence of tribes still living at the food-gathering and primitive hunting stages of social development.

Further—a fact to which too little recognition has been given in recent discussion—under all the Governments which are responsible for aboriginal administration, legislative measures have been taken for the official protection of the aborigines. The policy of the Queensland Government, as has been pointed out by the Agent-General in London (*The Times*, December 2), aims at the protection and elevation of tribalized and detribalized aborigines alike, the provision of medical attention, and—a most important function—the care of the cross-bred of superior type. Western Australia is taking measures to carry out the recommendations of the Royal Commissioner, to whose report reference was made in these columns at the time of its publication (see *NATURE*, 135, 798; 1935); while the Federal Government, in addition to its existing regulations for aboriginal protection, has recently appointed, in response to public opinion, an anthropologist as Protector of Aborigines.

Nor must the efforts of the missionary organizations be overlooked. They have done, and continue to do, excellent work, which is officially recognized as part of the organization for dealing with the aboriginal. Unfortunately, in consequence of conditions over which the missions have no control, their efforts in the long run add little towards the solution of the problem.

If, then, it may be asked, both Government policy and public opinion are prepared to help the

aborigines, how does it come about that all efforts are of no avail? Is it really the case that the race must inevitably die out, or is there perhaps some justification for the grave indictment of the Government and people of Australia by Prof. F. Wood-Jones and others? Prof. Wood-Jones in his valedictory address to the Victorian Anthropological Society, on leaving Australia for Manchester, it will be noted, returns to a charge which he made some years ago before the Australasian Association for the Advancement of Science. It is to be judged from the report of his address which has been published in England that he is of the opinion that, in the interval, nothing of any avail has been done to remedy the evils to which he formerly directed attention.

Setting aside the question whether the extinction of the race is inevitable from inherent causes as too large for discussion here, it may perhaps be said that among the many factors operative in present conditions and affecting the future, two stand out. Of these one is the character, mentality and traditions of the aborigines themselves, the other the general approach of the Australian Governments and still more of the people to the problem.

As regards the aboriginal, it has to be remembered that the race belongs to a very primitive stock, cut off from communication with the rest of the world at a very early stage of racial distribution, that it lives in an arid and difficult country where mode of life for hundreds of years, possibly thousands, has been adjusted with extreme nicety in equilibrium with environmental conditions. Upon this state of equilibrium an advanced civilization has impinged suddenly to throw it out of gear. Only under a prolonged period of tutelage will the aboriginal be able to adapt himself to changed conditions and new methods of gaining a livelihood. That he will be able to do so ultimately, his character and abilities, as now understood, afford assurance; but it must be a form of livelihood which so far as possible should be in harmony with his tradition, aptitudes and mentality. That he is not incapable of such training has been shown by the work which has been done by the missions. It is the duty of the Government by patient inquiry and expert investigation to determine on what lines he can be trained to take his part in the future development of Australia—not as a museum piece, but as an integral part of the community. In the meantime, the provision of land for reserves and of medical attention have

been rendered frustrate by the nomadic tendencies of the tribes, their inclination to drift to centres of white civilization and their mistrust of the white man's 'medicine'. To remove these difficulties in the way of protection should be the task of a sympathetic system of administration.

Secondly, the Australian people cannot be absolved from blame. Outbursts of popular indignation at the treatment meted out to the aborigines are of little avail, even when followed by legislation, if they do not also give rise to a sense of responsibility, constantly vigilant to see that regulations are properly carried out and that abuses are promptly eliminated. When the addition was made to the aboriginal reserves in central Australia to which reference has been made above, it was laid down that no prospecting for minerals would be allowed. Yet within two years, concessions for this purpose were being sought, and it was alleged at the time that the principal agent in the matter was one who had been most active in the agitation for securing the allocation of the reserve. Other encroachments on the reserves have been tolerated. Again, it is generally accepted that it is undesirable that police officers should be asked to undertake protection duties; yet in many instances the protectors are still policemen or officials whose other duties do not allow them to perform their function as protectors with efficiency.

It has been suggested that protection of the aborigines is a duty which should be and could best be undertaken by the Federal Government. Many hold this view. It is a matter that must be judged by the Australians themselves; but it would seem that, provided co-operation and unity

of policy can be secured as between the States, local interest might well serve as a nucleus of that strong and steady public opinion, at present lacking, which is essential to ensure that protective legislation is not only carefully framed, but also effectively put into operation.

It must seem to those who have had the advantage of examining successful systems of administration of native affairs elsewhere, that for the application of modern methods of native control, now accepted as essential for the well-being and future advancement of native races, the urgent need of Australia is a specially trained and efficient service of officers acting as protectors of the aborigines. Reference has been made in this discussion to the administration by the Australian Government of the native affairs of New Guinea and Papua. It is true that conditions there are very different from those of Australia; but they do at least afford this lesson, that for dealing with backward peoples with success it is essential that there should be sympathy and understanding, and that these qualities can be shown best by officers who are trained in the methods of anthropology. They need not be anthropologists in the special sense, but they should be trained to a degree that will ensure that they understand the customs and mentality of the people whom they have to control, and can deal with them with understanding. The cost of such a service in Australia—heavy as it will be—should weigh as nothing by the side of Australia's reputation for fair dealing, and possibly too as against the preservation of a people who one day may find a fitting place in the promotion of Australia's prosperity.

Land for the People

The Hill Lands of Britain:

Development or Decay? By R. G. Stapledon. Pp. 138. (London: Faber and Faber, Ltd., 1937.) 6s. net.

SCHOPENHAUER, in one of his discerning moods, divided authors into three classes: those who write without thinking—the most numerous; those who think as they write; and those who have thought before they write—they are rare. There is no doubt of the class to which the author of "The Hill Lands of Britain" belongs; in fact, he has thought so much, done so much, and has so much to say, that out of very exuberance

of spirit he sometimes forgets that language, like a living thing, has structure as well as function. His few lapses in this direction have prompted a well-known literary critic to pillory him for not being "an elegant, an easy, or a lucid writer". The indictment is far too sweeping: the author's meaning is never in doubt, his message rings clear and true.

Probably few of us realize how much of the green and pleasant land of Britain is sheer waste from the utilitarian point of view. Prof. Stapledon estimates that there are about 18 million acres of land, situated above 700 ft., covering not far short of one third of the land surface of Great Britain,

which produce little or nothing for supplying the needs, material or recreative, of our people. He describes these depopulated upland areas and indicates how and why they should be mobilized for national service. On some future occasion, we hope that he will write a companion volume on the reclamation and improvement of the thousands of acres of derelict and semi-derelict land that now disfigure the lowland countryside.

Agriculturally, the productivity of our hill lands, and of much land officially designated as 'rough-grazings', could be greatly improved by fairly simple means. Briefly, the necessary operations consist in breaking up the matted surface with tractor-drawn plough or cultivator, applying lime and phosphate, and, where economically possible, sowing suitable grass seeds together with plenty of wild white clover. This is not theory; the author and his co-workers at Aberystwyth have shown how it can be done on the uplands vested in the Cahn Hill-Improvement Scheme. To maintain and improve the fertility of farmed hill land, the fields should be kept under sown grasses for a period of two to six years; more use should be made of cattle for grazing, and crops like oats, kale, hardy green turnips, rape and Italian ryegrass should be grown for providing winter 'keep'.

It is not suggested that all the 18 million acres are immediately improvable, but about 25 per cent is; and the cost should not be unbearable. About £5 million a year should suffice for purchase and development of this land in the early years of a twenty-five year programme, and revenue would soon come in as rentals and taxation; for the author has come reluctantly to the conclusion that successful exploitation of the uplands for the national good can be achieved only through State ownership. The State would also benefit from the large amount of employment the scheme would give, and from the substantial addition that would be made to our supplies of home-grown food.

It must not, however, be thought that Prof. Stapledon's plans and ideas are confined to agricultural improvement and intensification. He has a great deal to say about populating our derelict upland districts, and providing urban dwellers with facilities for visiting and staying in them; about roads, tracks and transport, regional planning and education of the 'whole man'. In the last two chapters particularly, "The Non-Material Needs of the Nation" and "Dangers Inherent in Planning", he lets himself go, and gives us what almost amounts to a philosophy of right living (*savoir vivre*). For executing his plans, he does not look to the 'pure' scientist, with his nose impinging on the test-tube and his eye glued to the microscope, but rather to the scientifically educated man, like the engineer, who besides knowing how to turn knowledge into action, has rubbed shoulders with his fellow-men, and learnt to assess their faults and foibles as well as their virtues and capabilities. Nor can the author contemplate a multiplicity of administrative authorities, such as are now so common; he would absorb them into one supreme *ad hoc* authority, composed entirely of experts, like social biologists, agriculturists, foresters, engineers, surveyors, and psychologists. Although the last word would be with Parliament, all plans and administration would be carried out by experts on a wide regional basis. Excessive standardization would have to be avoided at all costs; development and happiness of the individual would be the supreme end.

"The Hill Lands of Britain" covers essentially the same ground as that of the author's larger work, "The Land: Now and To-morrow" (see NATURE, 137, 923; 1936), which it supplements and to some extent revises. There are many good things in it which have not been mentioned, but enough has been written to indicate that it represents a valuable epitome—scientific, practical, full of common sense and of uncommon vision. E. H. T.

The Cathode Ray Tube

(1) The Low Voltage Cathode Ray Tube: and its Applications. By G. Parr. Pp. x+177+6 plates. (London: Chapman and Hall, Ltd., 1937.) 10s. 6d. net.

(2) Television Cyclopaedia

By Alfred T. Witts. Pp. 151. (London: Chapman and Hall, Ltd., 1937.) 7s. 6d. net.

THE use of the cathode ray tube for television reproduction was suggested by A. A. Campbell Swinton so early as 1908, and although many

alternative schemes were explored in the succeeding twenty-nine years, the suggestion has borne fruit in its application to the present public television service in Great Britain. This remarkable stride in the development of radio communication has been made possible by the detailed technical improvement of the cathode ray tube, first as a laboratory tool and finally as a picture-reproducing device for use in the hands of the general public.

(1) The book by Mr. G. Parr deals with the sealed-off type of cathode ray tube operating at

accelerating potentials up to 3,000 volts. The fundamental principles of cathode ray tubes, both of the gas-focused and high vacuum types, are discussed, and the manner in which they may be operated to demonstrate their properties and performance is described. Two chapters are devoted to the various types of time base which may be utilized to delineate the wave-form pictures on the screen of the tube, and various engineering and industrial applications of the cathode ray tube are described. A concluding chapter outlines the manner in which the tube is applied to reproduce the television picture by the two principal methods which have been developed in Great Britain.

The book forms a very useful summary of the present stage of the development of the cathode ray tube, and its bibliography of some four hundred references should prove useful to those who wish to delve deeper into the subject.

(2) Since the subject of television involves a

knowledge of the technical aspects of both optics and radio communication, it is perhaps not surprising to see the issue of the "Cyclopaedia" by Mr. A. T. Witts. In this work, a large number of the terms used in television technique are arranged in alphabetical order and described by text, which ranges from a simple definition to a short article occupying two or three pages. Line diagrams accompany the text where this is considered to be useful.

On account of its arrangement in dictionary form, the book does not provide a suitable means of learning the principles in the science and practice of television; but it should prove a very useful work of reference to those who already have some knowledge of the subject. Although the work is not free from some errors and omissions, these are generally of a minor character. The reviewer must confess to his ignorance of the meaning of the word "defraction", which is used several times on pp. 133-34, but is not defined.

The New Cytology

Recent Advances in Cytology

By Dr. C. D. Darlington. Second Edition. Pp. xvi + 671 + 16 plates. (London: J. and A. Churchill, Ltd., 1937.) 21s.

THE first edition of this book, published in 1932, contained much useful data in the form of tables, diagrams and photographs, together with theories regarding chromosome behaviour. No serious student of cytology could ignore the book, which was a mine of information, and which sometimes annoyed and always stimulated the experienced worker. The second edition is not a mere reprinting of the first, but contains a great deal of extra material which will interest cytologists. Again we find tables, diagrams and illustrations, and signs of considerable assiduity by both the author and the publisher. So great are the additions of new material that the book is larger by more than a hundred pages, in spite of the fact that the large chapter on the "Evolution of Genetic Systems" has had to be omitted.

The changes that have taken place in cytology during the past five years can be seen by comparing the contents of the first and second editions. Very full descriptions of mitosis, meiosis, structural changes, polyploids, chiasmata, crossing-over, secondary pairing, origin and behaviour of sex chromosomes, and apomixis will be found in the second edition. The theories propounded to account for the phenomena appear more stabilized and their comparative importance can be more easily grasped in the new edition. Indeed, it would

appear that the main principles of chromosome behaviour in so far as they bear on genetical problems are now in a form acceptable to most cytologists. For the presentation of this alone the second edition is a valuable contribution. Other subjects, however, such as salivary gland (polytene) chromosomes, the prevalence and behaviour of inversions and "cell and chromosome mechanics", which have developed to a large extent in the last five years, are given prominence.

Considerable attention is paid in the book to the underlying causes of chromosome movement, spindle formation, and centromere action. Chromosome mechanics would still appear to be in a controversial state. It will be interesting to see if the various theories put forward in the second edition will be accepted in the future to the same extent as those of the first edition are at the present time.

As in the previous edition, there are a large and useful list of references and a glossary which contains many new terms. The majority of these are the production of the author and his co-workers. One can only imagine the number of new terms evolved by other cytologists, and the resulting difficulty in mutual understanding. An error in the definition of the *W* chromosome has crept in, while considerable humour is to be found under "Golgi Apparatus" and "Matrix". There has been more care in proof-reading, and in the preparation of the index, which, in the second edition, is a useful guide in searching for particular

information in the maze of inter-related facts, remarkable theories and astonishing phraseology. Even "quart in a pint pot" has been indexed. The index has been arranged in different type so that illustrations and diagrams may be distinguished from the letterpress. Led by the index to "epigenesis", one is rewarded by: "This is the principle of co-operation which is an *a posteriori* statement of the *a priori* doctrine of epigenesis". The remarkable changes in cytology

are also reflected in the relegation of parasynapsis and telosynapsis to the glossary.

This is a difficult book; but remarkable changes are still taking place in cytology. The author and publisher are to be congratulated on the production of a research monograph, profusely illustrated with diagrams and photographs, many of which are original, and containing a mass of data which will greatly stimulate workers in the field of cytology.

F. W. SANSOME.

Bird Life

(1) The Book of Birds :

the First Work presenting in Full Color all the Major Species of the United States and Canada. Edited by Dr. Gilbert Grosvenor and Dr. Alexander Wetmore. Vol. 1: Diving Birds, Ocean Birds, Swimmers, Wading Birds, Wild Fowl, Birds of Prey, Game Birds, Shore Birds, Marsh Dwellers, Birds of the Northern Seas. Pp. viii + 356. Vol. 2: Owls, Goatsuckers, Swifts, Woodpeckers, Flycatchers, Crows, Jays, Blackbirds, Orioles, Chickadees, Creepers, Thrushes, Swallows, Tanagers, Wrens, Warblers, Hummingbirds, Finches and Sparrows. Pp. 374. (Washington, D.C.: National Geographic Society, 1937.) 2 vols. 5 dollars.

(2) The Birds of the Malay Peninsula :

a General Account of the Birds inhabiting the Region from the Isthmus of Kra to Singapore with the adjacent Islands. By the late Herbert C. Robinson and Frederick N. Chasen. (Issued by authority of the Federated Malay States Government.) Vol. 3: Sporting Birds; Birds of the Shore and Estuaries. Pp. xxi + 264 + 25 plates. (London: H. F. and G. Witherby, 1936.) 35s. net.

(3) Check-List of Birds of the World

By James Lee Peters. Vol. 3. Pp. xiii + 311. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1937.) 15s. net.

(1) THE resources of the National Geographic Society have made possible the issue of a remarkably effective popular book on the birds of the United States and Canada. The text is contributed by a number of American ornithologists of high repute, whose names guarantee it as authoritative, and the extent to which the two volumes are illustrated is truly lavish. Prior publication in the Society's widely circulating magazine, over a period of years, has covered so much of the cost that the price is a low one for the value given.

Each important group of birds receives a chapter, in which an introductory account is

followed by details of the separate species. Other chapters are interpolated to deal more generally with such topics as the study of migration by the ringing method or the mechanical recording of bird-song. The treatment of some questions is perhaps superficial, and the style at times rather journalistic, but the information essential to a work of this kind is well presented.

The outstanding feature is the full use that has been made both of colour drawings and of photographs—there are more than two hundred of each. The coloured plates by Major Allan Brooks are beautifully clear, and well adapted for purposes of identification: all important species are depicted, often in more than one plumage. The photographs are from various sources and reach a high standard. They have obviously been selected to give an impression of the lives of the birds rather than of their mere appearance, and in this way they admirably supplement the portraits provided by the artist.

(2) Mr. Chasen now presents the third of five instalments of a guide to the bird-life of Malaya, the death of the author of the first two volumes having been the chief cause of a gap of eight years in publication. The work is a sumptuous one, and intended primarily for local use. Its general arrangement is unusual in that the division into volumes is based on habitat instead of following a strictly systematic order. Each species, however, is dealt with on a uniform plan, a description of the bird being followed by particulars of its range, nidification and habits. The information is lucidly set forth, and the plates by Mr. Grönvold are excellent.

(3) Mr. Peters is engaged in producing a work of reference of much value to ornithologists. The information given is restricted to nomenclature and distribution, but the utility of an up-to-date standard list of all known birds is obvious. The present volume covers the pigeons and the parrots, these two orders including between them more than sixteen hundred forms.

Why Aeroplanes Fly

By Arthur Elton and Robert Fairthorne. (The March of Time Series: Mechanics, 1.) Pp. xii + 82. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 2s. 6d. net.

THIS readable book discusses the subject more broadly than the title suggests, giving a chapter upon the uses of aircraft, even going into the question of its military values. The text follows faithfully the ideal laid down in the preface of giving "the reading public a detached, simple and untechnical explanation" of the subject matter; so much so that the reviewer feels inclined to suggest that the authors under-estimate the ability of the said reading public to understand the simple ideas of natural physics and mechanics. Nevertheless, it is almost entirely free from those loose and often inaccurate statements that are usually the inevitable accompaniment of the simplification of scientific matters.

It is easy to find faults of omission in any book which has obviously been kept down in size, but there are some cases in which the authors, having embarked upon an explanation, should not have left it unfinished. For example, when discussing high wing loading as a means of increasing carrying capacity, the attendant dangers of high landing speed are mentioned, but there is nothing about the many thoroughly tried and proved methods of increasing the speed range and reducing the landing speed. One would have been inclined to have accused the authors of being out of date but for the fact that in the next paragraph they mention retractable undercarriages as a means of reducing drag, a much more modern development.

Mention of a possible "new kind of engine made like a rocket" is a case of loose terminology. This surely means that the whole aircraft would be functioning on a rocket principle.

In general, a good book for the lay reader who has been so out of touch with the modern world that he is quite ignorant of the technical aspects of flight. The illustrations are particularly good, well chosen and well produced.

The Geology of South-Western Ecuador

By Dr. George Sheppard. With a Chapter on the Tertiary Larger Foraminifera of Ecuador, by Dr. Thomas Wayland Vaughan. Pp. xiv + 275 + 13 plates. (London: Thomas Murby and Co., 1937.) 25s. net.

DURING the past twelve years Dr. George Sheppard has published a series of papers on various aspects of the geology of Ecuador. In this volume, which is probably the first published in English on the geology of Ecuador, he puts on record his collected data and his conclusions. The present climate and physiography are described together with the effects produced by this type of climate. The origin of the Tertiary Clay Pebble Bed of the Santa Elena region is a matter of controversy. It has been suggested that it is a crush breccia on a regional scale, but Dr. Sheppard takes the view that it was originally of the

nature of a series of extensive mud streams similar to those which have been observed at the times of the heavy rains. He puts considerable emphasis on the results which may arise from these rather exceptional climatic conditions.

Some have regarded the Guayaquil Limestone as Cretaceous, but examination of the contained Foraminifera places the age as Eocene, and probably in the upper part of the series. In consequence of this and other evidence, Dr. Sheppard makes the tentative suggestion that the Guayaquil Limestone and the Seca Shales are of the same age.

Dr. Wayland Vaughan has contributed the chapter on the Tertiary Larger Foraminifera, and other chapters describe the geological structure, the igneous rocks and cherts, at some length. The final chapter deals briefly with the occurrences of petroleum.

An abundance of material is presented which provides food for thought on many points, but in giving his conclusions the author does not expect to go unchallenged on all the issues. G. D. H.

Plant Life Forms

By C. Raunkiaer. Translated by H. Gilbert-Carter. Pp. vii + 104. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 5s. net.

THIS type of botanical text will not be familiar to many British botanists, and therefore, although the original was written in Danish by Prof. Raunkiaer so far back as 1907, the point of view will be fresh and, indeed, invigorating.

Plants can be classified vegetatively into trees, shrubs and herbs, but this does not take the botanist very far. Most plants have to pass through a period of much-curtailed activity—winter in temperate countries and dry season in the tropics—and during this period, their growing parts, namely, the buds, must be afforded some means of protection. The degrees of protection vary according to the requirements of the different species. Prof. Raunkiaer describes the various means of protection, and these are illustrated by examples and drawings.

From this point of view, the plants are divided into the following main groups: (1) Phanerophytes, plants whose buds and apical shoots project into the air during the unfavourable season; (2) Chamæphytes, with buds and apices on shoots at or near the soil surface; (3) Hemicytrophytes, whose shoots die back just before the unfavourable period, so that surviving buds, etc., are protected by withered leaves and the soil; (4) Cryptophytes, whose surviving buds, etc., are either beneath the soil or at the bottom of water; (5) Therophytes, plants which pass their complete generation from seed to seed, that is, survive the unfavourable period as seeds. These groups are still further subdivided.

The value of plant life-forms to the study of plant geography can be well imagined, and a brief account of this is given at the end of the book.

Botanists will welcome this attractive book, and should be grateful to Mr. H. Gilbert-Carter for his excellent translation from Prof. Raunkiaer's original.

The Pleistocene History of the West Midlands*

By Prof. Leonard J. Wills

THE OLDER DRIFTS

The 'Older Drifts,' as already pointed out, are essentially either north-western (or Welsh) or north-eastern in composition. We may now examine them to determine whether they record more than one glacial epoch. For this purpose we can divide the region into two parts along a line running roughly from Derby—Lichfield—Tamworth—Coventry—Stratford-on-Avon to Moreton-in-the-Marsh.

East of this line two distinct sets of glacial deposits can be recognized on lithological and stratigraphical grounds. The older of the two, as developed in the north, is of Pennine origin, and was carried by ice travelling from the north-west; but near Coventry and Rugby, drift occupying an analogous position contains chalk and flints, and can be described as a sort of chalky boulder clay. Its apparent southerly limit is shown in Fig. 1. In the intermediate district little is known, but near Hinckley and perhaps also at Bedworth part of the older series consists of well-bedded, probably lacustrine deposits. The oldest drifts on the Blythe-Avon watershed near Stratford-on-Avon, and the 'Campden Tunnel Drift' near Moreton appear to be Welsh in origin with a slight eastern admixture. They have both been regarded as probably older than the Great Eastern glacier (Tomlinson).

Throughout all this eastern region the upper or more recent drift has been derived from the north-east and often consists of a true chalky boulder clay. It has generally and, I think, correctly been referred to the Great Eastern glaciation of Harmer.

Between the lower and the upper boulder clays in the Hinckley-Coventry-Rugby district there is a persistent bed of gravel and sand. Somewhat similar deposits, the Jurassic gravels of Miss Tomlinson, underlie the 'Main Eastern' boulder clay of the Stratford area. The 'Ditchford' or 'Paxton' gravels of the Moreton district occupy an analogous position with respect to the chalky 'Moreton Drift' (Tomlinson and Dines). In the Jurassic gravels near Stratford a single tooth of an archaic form of *Elephas antiquus* has been found, which is suggestive of interglacial conditions. Near Coventry both cold and warm climate fossils have been recorded by Shotton. In

view of the close association of these deposits with two glacial series, the presence in them of tundra and temperate fossils is not so contradictory as would at first sight appear, especially as we must allow that vast lengths of time may, in a watershed area, be represented by comparatively thin deposits.

I consider that the facts in this eastern region support the idea of two distinct glaciations within the Older Drifts, with interglacial conditions between them (*First Interglacial*).

West of the Derby-Moreton line the area of the Older Drifts is sharply limited on the north by the southern edge of the later Main Irish Sea glacials (Fig. 1), which has already been discussed. Except in the Lower Avon valley, the older drifts are here Welsh.

The interpretation of these drifts is extremely difficult, partly because it is likely that if there have been two glaciations, they will be recorded by similar deposits which might occur each separately or both together on the same surface, and partly because of the great dissection and destruction that they have undergone. Many of the deposits, too, are gravels and sands that belonged rather to outwash fans than to the ice sheet itself. On the other hand, we have, as already pointed out, the river terraces to help us, by providing a record of the progressive deepening of the valleys and of the contemporaneous opening up and development of new lines of drainage on surfaces, each of which appear to grade with one or other of the terraces, and which for this reason may be regarded as of approximately the same age as the terrace in question.

We may consider the Lower Avon and Lower Severn vales first. Here the highest deposit, namely the Woolridge Terrace, is developed between Tewkesbury and Gloucester, and up the Leadon valley at heights between 200 and 285 O.D. I have elsewhere suggested that the Leadon valley deposits were laid down by water travelling west of the Malvern range and forced to take this course by the filling of the Severn vale by the Welsh ice, when at its maximum. At this stage, too, the ice seems to have carried Welsh boulders to the Moreton-in-the-Marsh district and to have been responsible for certain very high-level drifts in Worcestershire. For these reasons I picture it as stretching over the vales of Severn and Avon

Continued from page 997.

to the Cotteswold escarpment. A slight retreat would have allowed outwash material to be laid down below Tewkesbury. Patches of this have survived at Woolridge (260 O.D.), Norton Hill (283 O.D.), and Corse Hill (250 O.D.). These and some other very high deposits seem to belong to this early stage and to be the most likely equivalents of the lower boulder clays of the Upper Avon valley and of the Pennine drifts of the Trent, Soar, and Wreak valleys.

If we accept this view, it follows that the retreat of this *First Welsh Glacier* was connected with the 'first interglacial' episode for which we have discussed the evidence in the Upper Avon valley. In the Lower Severn vale the Bushley Green Terrace, containing a temperate shell fauna and lying at a considerably lower level than the Woolridge Terrace, appears to belong to this time. The Bushley Green correlates with the Avon No. 5 Terrace of Miss Tomlinson, but for several reasons I picture the latter as somewhat later in date though graded to about the same level. On this view the Bushley Green and Avon No. 5 Terraces cover the 'first interglacial' episode and the on-coming and maximum stage of the Great Eastern glacier in the Avon Vale.

What then of the rest of the region? There are certain data and several lines of reasoning* which in my opinion justify us in postulating the existence during the Great Eastern Glaciation of a Welsh ice sheet reaching across the Stour and Salwarpe valleys, and covering the Black Country, East Worcestershire and the Warwickshire Plateau (Fig. 2). There is, however, no clear-cut evidence to prove whether it was the shrunken First Welsh, or, as I think more likely, a *Second Welsh* ice-sheet which, as the first interglacial epoch passed away, grew and invaded the northern part of the same region, incorporating to some extent in its deposits the drifts of the earlier advance.

The retreat of this glacier is illustrated diagrammatically in Fig. 2.

The first position shown is indicated by a line with double offsets. This line conforms with Miss Tomlinson's maximum 're-advance' in the Blythe valley; with the considerable development on the Ridgeway of drifts with both north-eastern and north-western erratics which may have owed their origin to the combined efforts of the two glaciers; and with the gravels and sands of the Stoulton-Besford area which I have just referred to as grading to the same level as Avon No. 5 Terrace. As the two sheets withdrew, the drainage down the Avon was responsible for the formation of some parts of the same terrace. It appears necessary to imagine the Severn valley from Worcester downwards as having already been

established, possibly as a marginal flow along the edge of the First Welsh Glacier.

The second stage deserves more elaboration; but this cannot yet be achieved, owing to want of data. The line indicated with three offsets must therefore be regarded as a composite representation of several that it would be necessary to draw in order to satisfy even the evidence we now possess. East of Birmingham the line represents a lobe in the Tame basin connecting near Tamworth with the Eastern ice of the Anker and Trent valleys. This disposition of the two sheets would enable us to account for the Blythe valley lake suggested

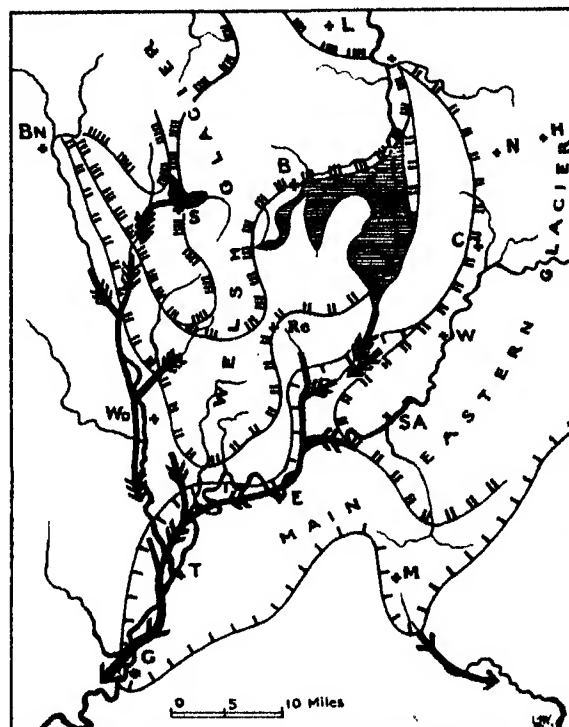


Fig. 2.

POSSIBLE SUCCESSIVE STAGES OF RETREAT OF THE SECOND WELSH AND OF THE GREAT EASTERN GLACIERS. HORIZONTAL RULING INDICATES GLACIAL LAKES; ONE-BARBED ARROW, BUSHLEY GREEN TERRACE OF SEVERN, AND WOLVERCOTE TERRACE OF EVENLODE; TWO-BARBED ARROWS, AVON NO. 5 TERRACE; THREE- AND FOUR-BARBED ARROWS APPROXIMATE TO THE KIDDERMINSTER TERRACE.

in the Birmingham Memoir and described by Miss Tomlinson. It drained southwards by the Kingswood Gap to the Alne valley during the Stratford stage of the Great Eastern Glacier (Tomlinson).

Ice approximately in the position shown for this stage could also account for the Cole valley lake, the Moseley gravels, and the barrier of sands which turn the Cole eastwards near Castle Bromwich. Fig. 2 also indicates a lake in the upper Rea

* These are outlined in the printed address.

valley, south-west of Birmingham. This expresses the hypothesis that certain clays, such as the 'india-rubber clay' of California and the similar deposits at Parson's Hill, King's Norton, may have originated as lake clays when the Rea valley was obstructed by ice that impounded water up to about 550 O.D.

The line further coincides to the south-west of Birmingham with the gravel deposits of Rowney Green near Alvechurch, which may be regarded as marginal in origin. The lobe stretching southwards complies with the necessity for an extension into the lowlands of an ice-sheet that was mighty enough to overspread the high ground of the Black Country and the Lickey Hills. Drainage from this was carried away along the Salwarpe into the Severn, and was responsible for part of the erosion of these valleys before the Kidderminster Terrace came to be formed. It will be noted that the overflow from the Blythe lake coupled with drainage from the retreating Eastern glacier produced similar erosion-effects in the Avon valley before Avon No. 4 Terrace was laid down.

Returning to the melting glacier, the next event seems to have been the splitting of the ice on the high ground of the Black Country. The lobe on the west I picture as occupying the low ground west of the coalfield and of the Clent-Lickey range as far south as the Salwarpe valley. It was this ice that held up the lake or lakes near Wildmoor and Barnt Green which have left their record in the horizontally bedded high-level sands and gravels of that district.

As the ice shrank back the thick mounds of sand and gravel in the Stour vale and near the Churchill brook were deposited. These clearly antedate the Kidderminster Terrace and so fall into their correct position in the scheme.

The final stage, indicated on Fig. 2 by a line with five offsets, was suggested to me by Mr. T. H. Whitehead. There is much evidence to justify the assumption that in pre-Glacial times the Stour flowed northwards as far as Hinksford, where it rounded the end of the then unbroken Bunter Pebble Bed escarpment. Ice in the position shown on the map would, as already suggested, have impounded a lake in the upper Stour valley, the overflow from which might have initiated the present gorge of the Stour through the Bells Mill Gap. The sands of the so-called Kingswinford Esker can be regarded as having originated in this lake.

All the records of the further retreat of the Welsh ice sheet have been obliterated by the invasion of the later Main Irish Sea glacier.

The evidence relating to the Older Drifts that we have been considering is scattered, difficult to

interpret and usually ambiguous; but nevertheless I feel some confidence in the correctness of the main features of its interpretation, namely, that there were two glaciations involved. In the first the ice movement was from North Wales and the Pennines towards the south-east: in the second there was a similar, but less powerful North-Welsh dispersion with some slight intermingling of Irish Sea material. Simultaneous with this, however, in the east and in the Avon valley was the Great Eastern glacier.

By the end of the First Glacial epoch the general trend of the lowest parts of the Severn seem to have been established as marginal channels bordering the ice which lay thickest in the Salwarpe-Piddle Brook depression. The first and the second glaciations were probably separated by truly interglacial conditions (First Interglacial).

The Second Glaciation came to an end in the *Second or Great Interglacial* epoch which intervened between the deposition of the Older and Newer Drifts. In the area under review we find at this stage that the present directions of the rivers had been determined, and that the valleys of those days can be recognized and their depths defined by the Kidderminster-Avon No. 4 Terrace, and perhaps by the 'High Terrace' with *Hippopotamus* in the Trent valley. There is, however, one exception to this statement. I refer to the Iron Bridge gorge. This section of the present river was non-existent at this time, and in its place was a high watershed. The diversion of the Upper Severn across this waterparting belongs to the story of the Newer Drifts.

NEWER DRIFTS

(a) *The Main Irish Sea Glaciation.* I can only refer in the very briefest way to the events that have occurred since the 'Great Interglacial.' I have already mentioned that the Newer Drifts in the Midlands were the product of the *Main Irish Sea Glacier*, and I have attempted to define its maximum extent on Fig. 1. This glacier belonged to the *Third Glaciation*.

The oncoming of this glacier seems to have coincided with the deepening of the Severn valley below the Kidderminster Terrace level, in preparation, as it were, for the great floods of sand and gravel that were fed into it as soon as the ice crossed the old watershed near Iron Bridge and at the head of the Worfe and Smestow valleys. These deposits are now the Main Terrace, correlatives of which are the Second Terrace of the Avon and probably the low terraces of the Trent and Tame.

As the ice had been moving upstream in its invasion of the Dee and Mersey basins, it must

have impounded the drainage during the advance, as we know it did later during the retreat; but there seems to be no record of an overflow into the Severn catchment during this growth stage. As the ice melted back from the maximum position shown on Fig. 1, a series of important drainage changes took place. First, at an early stage when the ice still covered the watershed at Iron Bridge and at the head of the Worfe, but had melted back enough to expose the upper Penk valley, a small lake was impounded just north of Wolverhampton which flowed out south-westwards over the watershed near Tottenhall, forming the Tottenhall Gap. This overflow was responsible for the great train of gravels full of Irish Sea erratics that follows the Smestow Brook down into the Stour.

Dixon has traced various ice fronts trending in a general north-easterly direction across the country between the Penk and Newport, Salop. These are marked by terminal kames and by beaded asar.

The Worfe valley was an important line of drainage from the ice front until the latter came to lie on the north side of the watershed. In this position a lake was impounded near Newport, and Dixon has shown that this drained across the watershed at Gnosall into the Church Eaton brook and so into the Trent. He named it Lake Newport.

I have elsewhere described the detailed evidence relating to the way in which the waters of the Upper Severn came to be diverted through the Iron Bridge gorge into the drainage basin of the present Middle and Lower Severn. This diversion was brought about during the melting back of the Main Irish Sea Glacier on the watershed region near the Wrekin, through the development of a system of marginal channels and glacial lakes. The detailed evidence substantiates a hypothesis suggested independently by both Lapworth and Harmer, the main feature of which was that a lake was held up by the ice sheet on the north-west side of the pre-glacial watershed at Iron Bridge; and that this lake drained away across the divide, and thus initiated a gorge that became so deep that it has permanently retained the Upper Severn drainage which formerly went out to sea either by the Dee or by the Mersey. This lake I named Lake Buildwas.

At this stage then there were two lakes, Buildwas and Newport, on the north-west side of the watershed, one draining to the Trent and one to the Middle Severn. They were separated by the ice where it impinged on the Wrekin. When the glacier melted back farther and allowed the lakes to join and form 'Lake Lapworth,' so nearly at the same level were the outlets that it was a mere

matter of chance that the Upper Severn went permanently to the Bristol Channel and not to the Humber. As it happened, the Iron Bridge outlet was, or at any rate soon became, the lower. It took all the discharge and has retained it ever since.

These glacial accidents have been the factors that have determined much of the geography of the Midlands; for they diverted into the relatively small pre-glacial catchment basin of the Lower and Middle Severn great volumes of water which have rejuvenated the river, especially in its middle reaches, on a stupendous scale. The rejuvenation is still operative, and can be seen today in the erosive activity of every tributary of the Middle Severn.

Climatic conditions during the Main Irish Sea glaciation were extremely severe. Solifluxion and melt-water floods were on a correspondingly grand scale in the periglacial region. There are vast spreads of local, often angular, detritus at the foot of the Cotteswold and Malvern Hills, and in the valleys draining the high ground of Enville and the Clent-Lickey range, which resulted from these conditions. Most of these grade down to the Main Terrace level in the adjacent valley, and may be correlated with that terrace and thus with the third glaciation; though some seem to be still younger and to correlate with the Worcester Terrace and the Welsh Re-advance.

(b) *The Welsh Re-advance* or Little Welsh Glaciation.* The fourth and last glacier to reach our area was an extension of the Upper Severn valley-glacier down as far as Shrewsbury, to which Whitehead has given the name *Welsh Re-advance*. There is strong evidence that the lowest of the important Severn Terraces, the Worcester Terrace, was being formed during this re-advance.

The problem of the Welsh re-advance is one among many relating to our glaciations that await solution, and yet can never be solved by work in one restricted area. The cry is always for accurate data in neighbouring areas. I close this address, as I began it, by an appeal for amateurs who are willing to undertake conscientiously and scientifically the recording and co-ordinating of every scrap of evidence in the district in which they live, whether it be a glacial or a periglacial one. If this were done so carefully that no temporary exposure escaped record, data would gradually, but I think quickly, accumulate by which some at least of the many outstanding problems of glacial correlation and interpretation would reach solution.

* The map, Fig. 1, does not attempt to show the limits of this along the Welsh borderland, as worked out by Dwyerhouse and Miller and by Charlesworth, since they lie wholly outside the Midlands.

The Soviet North Polar Station

WHEN the Soviet polar station was founded on an ice-floe near the North Pole on May 21, 1937, it was expected that the floe would drift slowly, perhaps erratically, but on the whole towards the northern coast of Greenland. The outflow of ice from the Arctic basin by the East

Service give some details. Until early November the drift was steadily southward along the meridian of Greenwich, with deviations of about seven degrees of longitude to east and west. Then during November the course became south-east towards Spitsbergen, and on November 30 the position was lat. $82^{\circ} 51' N.$, long. $7^{\circ} E.$ Thus the station is now approaching the course of the final stages of the drift of Nansen's *Fram* in 1896. The *Fram*, with a slower and less decided course, moved on the whole to the south-west from the vicinity of the New Siberian Islands to lat. $84^{\circ} N.$, long. $15^{\circ} E.$ and then southward. Thus there would appear to be a certain parallelism between the two drifts, with the suggestion that the quicker drift of the Soviet station is due to its being in the main trend of the current while the *Fram* was in the peripheral regions, where wind may at times have controlled the course.

Until November the floe with the Soviet station was moving definitely towards the East Greenland current, which is the main outlet of the ice of the Arctic Ocean. This current may well have been drawing it in that direction. The change of direction in November is more difficult to explain. Possibly wind action may be a factor of some importance as the pack approaches the periphery of the basin and there is less congestion, as is suggested regarding the *Fram's* route, or there may be eddies on the margin of the main stream.

On December 12, however, the floe was reported to be in lat. $82^{\circ} 8' N.$, long. $7^{\circ} 45' W.$, so that it is now moving towards Greenland.

If the drift continues, as seems probable, the position of I. D. Papanin, E. Krenkel, E. L. Federov and P. P. Shirshov will become one of extreme danger, although their wireless messages make light of their peril. Rumbings in their floe indicate cracking: dissolution may quickly follow if the floe reaches the edge of the pack and feels the influence of ocean swell. That will be some time yet, but probably will occur during the winter and not as had been hoped in summer daylight. Until March there will be no daylight at the station: darkness will materially increase the difficulty of aeroplanes finding an adequate landing place for the rescue, and the explorers have no

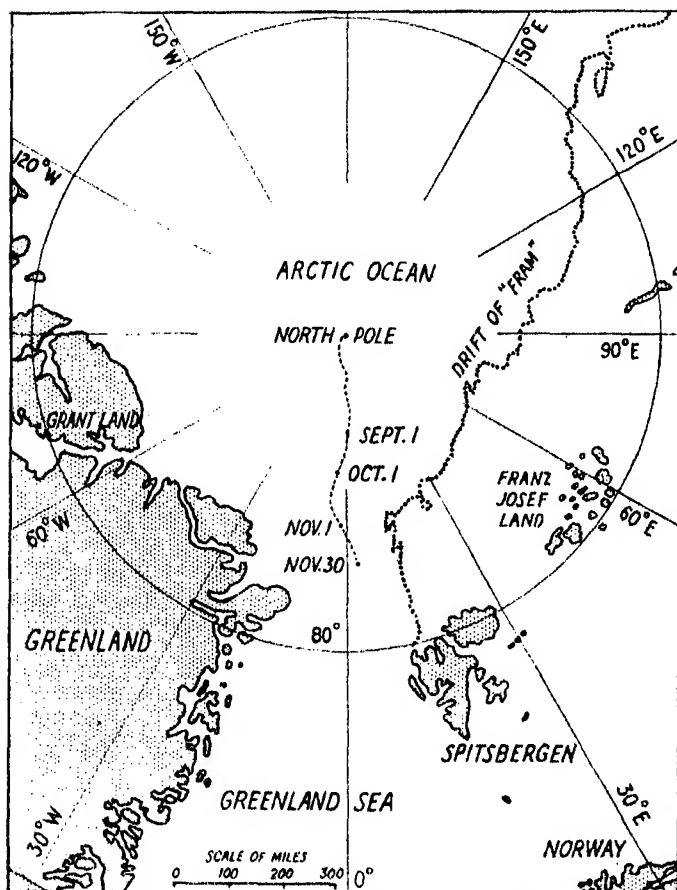


CHART SHOWING DRIFT OF THE SOVIET POLAR STATION (broken line)

Greenland current, the observed westerly drift of floes to the north of Greenland and the heavy hummocky ice off Smith Sound and Grant Land, Nares' misnamed palæocrystic ice, all point to the probability of a more or less rotatory drift within the Arctic basin. There can be little doubt that some of the Arctic pack-ice is carried, at least at times, by such a drift, which is no doubt partly due to the earth's rotation and is assisted by the prevalent atmospheric circulation.

The Soviet station, however, has not closely followed the anticipated course. News in *The Times* and the Soviet Union Year Book Press

vessel. There are reports that the Soviet Government intends to send an ice-breaker to the rescue. This plan holds out more hope. On the other hand, the floe may continue its drift towards north-east Greenland. In that event the explorers may be able to effect their own rescue by travelling over closely packed ice, held by the land, to the safety of the shore. It is much to be hoped that these gallant men, who have risked much in the cause of scientific investigation, succeed in reaching safety.

Up to the present, their meteorological records alone have been published, but it is clear that the ocean soundings are going to prove of great interest, as showing a uniformity of depths in high latitudes and defining the width and depths of the ridge connecting Greenland and Spitsbergen. Other oceanographical discoveries were referred to in a previous article in *NATURE* (139, 990, June 12, 1937).

R. N. R. B.

Obituary Notices

Sir Jagadis Chandra Bose, C.S.I., C.I.E., F.R.S.

BY the death of Sir Jagadis Chandra Bose on November 23, a few days before his seventy-ninth birthday, India has lost one of her foremost sons and science one of its most picturesque figures. In India, and indeed elsewhere, Bose's concern for the well-being and progress of his native country has for long been widely known. His reputation as a physicist has been established for several decades. But it is at present not possible, and will not be possible for some time to come, to assess the true value of his contributions to physiology.

Bose's physiological work still remains in an isolated position in spite of decades of indefatigable work on his part, many volumes of published experimental work, and sometimes even unique facilities granted, not only in his own country, but also in Great Britain, the United States and on the Continent, to bring his results personally before the public by means of lectures and demonstrations. (In his earlier days, such facilities were not always available, and it is a tribute to his fighting instinct that he was able to obtain them in the end.)

The reasons for Bose's isolated position in the science of physiology are many and varied. Although he was a pioneer in his own field, he seldom discussed his results with those of his contemporaries. His scientific work was at times almost dramatic, with the result that even at the early stages he attracted much attention from the non-scientific world. Diplomats and high Government officials attended his discourses; Romain Rolland was loud in his praises of him; Rabindra Tagore wrote poems eulogizing his work; and Bernard Shaw was attracted to one of his lectures. Naturally, lay publicity and interest followed such distinguished example; but all this was unhealthy to Bose, the man of science, when so little of his work had received scientific confirmation.

Jagadia Chandra Bose was born in the village of Barukhal in Vikrampur, a large area in the Dacca District, on November 30, 1858, the son of Bhagaban Chandra Bose. But Bose's father soon migrated as deputy magistrate to Faridpur, the centre of the next District, and it was there that Bose spent his childhood days. Bhagaban Chandra Bose had a profound

sense of public duty, and it was doubtless from this source that Jagadis Chandra Bose's supreme love and work for his fellow countrymen had their origin. Bose's father, too, had to grapple with the severe problem of the dacoits in his area, and his success won unstinted praise from the authorities. Such factors were no doubt operative in eliciting that note of strenuous and persistent courage in facing adversities and of untiring combativeness against every difficulty so inherent in Jagadis's character throughout his life.

By his father's wish, Bose received his primary education at the vernacular school in Faridpur, and not the English school. Thus did he at an early age come into contact with the problems of the peasant, and those problems always occupied his mind afterwards. At nine years of age he entered St. Xavier's School in Calcutta, where his taste for natural history veered round to one for physics under the influence of Father Lafont. He graduated B.A. at the age of twenty years.

At this time, his family was financially embarrassed, but chiefly through the help of his mother, Bose was enabled to leave Calcutta for the University of London to study medicine. In later years, he was never tired of describing the thrills he experienced in studying zoology for the first time under Ray Lankester. But his health forced him to leave London, and, having gained a natural science scholarship, he entered Christ's College, Cambridge, in 1881. His first year there was one of indecision, but he was an assiduous student of physiology under Michael Foster and embryology under Francis Balfour. In his second year, he settled down finally to botany under Vines and Francis Darwin, chemistry under Liveing and physics under Rayleigh. He took the Natural Sciences Tripos, obtained his B.A. and at the same time took a London B.Sc. In later years, his former teachers, Lord Rayleigh and Prof. Vines, were appreciative of his researches in physics and physiology, and were sponsors for their presentation before the Royal and Linnean Societies respectively.

Bose returned to India at the age of twenty-five years, and, after serious opposition from the Educational Service and from academic authorities, was appointed professor of physics in Presidency College,

Calcutta. Here his lectures were brilliant and his influence over the students profound. Thus finally did he gain the full approbation of the Principal of his College and the Director of Public Instruction.

Having thus overcome preliminary opposition and difficulties (though there were many more in store), Bose determined that henceforth his life should be devoted not to professional survival or family honour, but to the pursuit of scientific truth. How tenaciously he adhered to that resolution throughout his career is practically common knowledge. Through it, especially in his own country, he won the love and admiration of everyone.

Bose's first researches were on electric radiation, and within a year the Royal Society undertook the publication of his investigations and provided financial help for their continuation. About the same time he was awarded the degree of D.Sc. in the University of London. Thus did his first piece of research work win authoritative approval. Kelvin too was enthusiastic in his praises of Bose's physical researches: but all this meant chiefly one thing to Bose—that India was coming forward in scientific research. So at that time he decided that India should have its own scientific research institute: but he was still faced with much opposition so he concluded that anything done in such a direction must be done by himself. However, it was not until another twenty-five years had passed, during which both he and his wife practised the strictest economy, that he was able to realize his dream and open the Bose Research Institute in Calcutta.

Having justified his claim as a physicist, Bose received every encouragement from his own Government and from the Imperial Government.

About the same time that Lodge was extending Hertz's work on electrical radiation in England, Bose was doing similar work in India. With his perfected apparatus, he carried out his now familiar work on electric waves. He was able to verify the laws of reflection and refraction, determine refractive indices and wave-lengths (by curved gratings) and exhibit polarization and double refraction by pressure and unequal heating. In 1896, this work received the highest praise from Sir Oliver Lodge and Lord Kelvin, and Bose was acclaimed as the first Indian to win distinction through scientific work. On the Continent and throughout Asia, too, his work in physics received distinct approval from such men as Lippmann, Quincke, Warburg, Lenard and others, and as the outcome of it all, British men of science, including Lister, Kelvin, Dr. Gladstone, Poynting, Stokes, Silvanus Thompson successfully appealed to the Government to establish a well-equipped physical laboratory in Presidency College. But there was much delay, and the laboratory did not materialize until 1914, shortly before Bose retired from the chair. Further experiments with his electric refractometer were communicated to the Royal Society in 1898 when he described determinations of the indices of refraction of various substances and the influence of the thickness of the air-space on total reflection of electric radiation. In 1900 he contributed a communication to the Royal Society on molecular changes

produced in matter by electric waves, in which he made some interesting observations concerning the phenomenon of fatigue in metals. This marked the beginning of his interest in response in the inorganic and in the living.

At the beginning of this century, Bose's well-known, though little understood, work in physiology began, and he read his first paper on the response of inorganic and living matter before the International Conference of Physics meeting in Paris in 1900. This paper caused considerable discussion, and he read a similar paper at the British Association meeting at Bradford in the same year. Here he described the magnitudes of changes produced in the molecular structure of inorganic and living substances due to an electric stimulus, and was able to show that from this point of view both types of substances are similar. On this basis, he constructed an artificial retina that enabled him to explain many phenomena of vision which up to that time had been obscure. Both physicists and physiologists attended this paper; the physicists were enthusiastic, but the physiologists were cool.

At the invitation of Rayleigh and Dewar, Bose continued his researches along these lines in the Davy Faraday Laboratory of the Royal Institution. He then returned to India. Though during 1900-3 he continued his researches both in England and in India on the theme of response in the inorganic and the living and had his papers read before the Royal Society, they were not published owing to the opposition of some physiologists. A paper was read before the Linnean Society of London under the sponsorship of Vines, Horace Brown and Howes. In this he discussed the electric responses in ordinary plants under mechanical stimulus. His experimental results showed, he claimed, that the response of the ordinary plant organism, so far as fatigue, temperature, poisons, anaesthetics, etc., are concerned, is identical with that of animal muscle and nerve. Similar results communicated to the Royal Society in 1903 were not published. But from 1902 until 1919 he published six volumes of his experimental investigations and conclusions and many papers on his 'physics of physiology'. In his 'Responses in the Living and Non-Living' he claimed to have demonstrated "a complete parallelism . . . between plant response on the one hand and that of animal tissue on the other" and, referring back to his earlier physical experiments on the 'electric eye' he claimed to have shown that "there is not a single phenomenon in the responses, normal and abnormal, of the retina which has not its counterpart in the sensitive cell constructed of inorganic material".

Thus did Bose's earlier work in physiology meet with much active opposition: but this gradually subsided and eventually some of his work appeared in the publications of the Royal Society and other societies. On November 30, 1917, he was able to realize his dream of a quarter of a century and open the Bose Research Institute in Calcutta. This includes departments of physics and plant and animal physiology. Active research continues there. The funds were supplied by him and from Government grants.

Bose had a genius for designing delicate and sensitive apparatus for his physiological investigations, fertility in initiating new lines for observation and a clear style of setting out his experimental results and theoretical deductions. Nevertheless, by his resonant recorder and oscillating recorder he actually did for the first time record the delicate movements of leaves of *Mimosa* and *Biophytum* without distortion. He also devised apparatus for demonstrating the effect of sleep, air, food, drugs, excitation, impulse, etc., on plants. He also demonstrated an instantaneous record of growth and death. Thus, according to him, did the plant automatically record its own physiological life-history. In 1919, he announced that he had obtained in plants very definite mechanical and electrical response to wireless impulses, and claimed that the "perceptual range of the plant is inconceivably greater than ours: it not only perceives but also responds to the different rays of the vast æthereal spectrum". His high-magnification crescograph which magnified the growth of a plant ten million times was received with enthusiasm in England in 1919-20. Doubt had originally been cast on the crescograph really recording growth magnification, but after demonstrating his apparatus in University College, London, a letter appeared in *The Times* of May 4, 1920, over the signatures of some of the leading British men of science stating that "the growth of plant tissues is correctly recorded by this instrument and at a magnification of from one to ten million times".

Bose received the C.I.E. for his scientific work at the Delhi Durbar in 1902. In 1911 he was awarded the C.S.I., and in 1915 he retired from the chair in Presidency College as emeritus professor on full pay. In 1917 a knighthood was conferred upon him, and in 1920 he was elected a fellow of the Royal Society.

Comment on Bose's praiseworthy work in physics would be superfluous: but he would be a daring man who attempted any precise evaluation of Bose's work in plant physiology at this stage. His work was prolific and his publications voluminous. He published a large number of books, and the "Transactions of the Bose Research Institute" contain much of his own work and much carried out in collaboration with others. Most of this work has been received in silence, and has neither been confirmed nor openly refuted. In any event, never will it be truthfully said that Bose was not a potent stimulus to contemporary physiologists, especially at the height of his career. A leading physiologist once said that Bose's "more general conclusions will probably not attract so much attention as the new experimental methods he employed". But the application of Bose's methods in experimental physiology by other investigators is still to come.

Of Bose, the man, nothing but the most gracious and kindest thoughts can be entertained. He was a great patriot and took a deep interest in Indian culture; and his wider interests are shown by his former membership of the International Committee on Intellectual Co-operation of the League of Nations. Sir Jagadis is survived by Lady Bose, who for many years was a source of encouragement to him.

Dr. K. J. Saunders

DR. KENNETH J. SAUNDERS, whose death at the age of fifty-three years occurred at Eastbourne on November 22, was an orientalist and authority on the religions of Asia of no little distinction.

Dr. Saunders was educated at Clifton College and Emmanuel College, Cambridge, of which University he was a D.Litt. From 1909 until 1912 he was a lecturer of Trinity College, Kandy, and it was in this period, through his contact with the Buddhist monks of Ceylon, that he acquired an insight into the practical working of the Buddhist faith. This determined his line of approach to the comparative study of the religions of the East as 'ways of life', which he demonstrated most strikingly in his studies of similarities in the doctrines of Buddhism and the teachings of Christ. He was also strongly impressed by the influence of Buddhism in the spread of the culture of India and Ceylon to other countries in Asia. These views on the place of Buddhism in the life and culture of the East were strengthened by a period of residence in Burma, when work for the Y.M.C.A. brought him into intimate contact with native students; and they were confirmed and deepened by pilgrimages to Buddhist shrines and centres in other parts of Asia, especially China and Japan, which he visited after the Great War.

Dr. Saunders was later appointed to the chair of comparative religions in Berkeley University, California, which he held until 1935. In the two following years, he was engaged in lecturing on Asiatic history; but a breakdown in health prevented him from taking up his duties on appointment to the recently founded Spalding chair for the study of comparative religions in the University of Oxford.

WE regret to announce the following deaths:

Dr. O. C. Bradley, principal of the Royal (Dick) Veterinary College, Edinburgh, since 1911, on November 21, aged sixty-five years.

Mr. Edward T. Browne, a governor of the Marine Biological Association of the United Kingdom and a generous benefactor to science, well known for his zoological work on medusæ, on December 10, aged seventy-two years.

Prof. J. Handerson, professor of natural history in the Colorado Museum, an authority on invertebrate palæontology, on November 4, aged seventy-two years.

The Rev. Walter Howchin, emeritus professor of geology in the University of Adelaide, aged ninety-two years.

Prof. A. Hutchinson, O.B.E., F.R.S., formerly professor of mineralogy in the University of Cambridge, lately master of Pembroke College, on December 12, aged seventy-one years.

Prof. Hans Molisch, formerly professor of botany in the University of Prague, on December 8, aged eighty-one years.

Mr. George Philip, chairman of Messrs. George Philip and Son, Ltd., geographical publishers, and author of several valuable library atlases, on December 8, aged sixty-seven years.

News and Views

Population Statistics

SIR KINGSLEY WOOD, the Minister of Health, has taken to heart the criticisms of the schedule of the Population (Statistics) Bill which have been brought forward, both in and out of Parliament, since its publication. The revised schedule omits altogether the comprehensive Clause 3, which made it possible to demand information upon "any other matter", and was much disliked. The questions now to be asked are definite and simple. On registration of birth: the age of the mother; the date of marriage; the number of former children of the mother. On registration of death: whether the deceased was married; if a woman, the date and duration of marriage; the number of children; the age of the surviving spouse. The information so obtained will not be disclosed to the public. These are not provocative questions and it may be expected that they will be approved by Parliament. The history of this Bill shows our democratic institutions at their best. We have, first, a Bill with a vague and complex schedule, calculated to give rise to objections, and covering more ground than was really required; then an excellent, critical debate in the House of Commons, and a good, general discussion in the newspapers; and, finally, the revision and simplification of the Bill by a sensible Minister.

Air Raid Precautions

IN his speech on the motion for the third reading of the Air Raid Precautions Bill in the House of Commons on December 7, Sir Samuel Hoare emphasized that air raid precautions, on however great a scale, cannot assure complete immunity to the population of Great Britain or any other highly industrialized European country. The most that can be done is to minimize the catastrophe and loss of life and to ensure the essential defence service. It is also impossible to concentrate on passive defence a disproportionate amount of money and man-power. Air raid precautions have their proper place in a general scheme of defence finance and preparation, and Sir Samuel expressed the opinion that the execution of the Government's plans would go far to prevent panic and ensure the continuance of the essential services. When the Bill reached the Statute Book the Government proposed to make much greater use of experiments in co-operation with local authorities and to strengthen the air raid precautions organization of the Home Office. In addition, very considerable steps are already being taken in Government Departments to organize air raid precautionary methods. About fifty instructors drawn from different departments have received training at the civilian anti-gas school and are giving instruction to the staffs of departments. About eighty instructors trained in the same manner have been supplied to the Post Office, and it is hoped by the end of the year that

there will be more than 150 instructors in the Post Office service alone. Seven gas chambers are being constructed in various Government buildings in the London area by the Office of Works, and the Office is also carrying out an extensive structural survey of existing Government buildings. The most suitable accommodation will be ear-marked for refuges to which the staff will be collected on receipt of an air raid warning.

STRUCTURAL precautions against air attack will be considered in all new Government buildings, and in the new Whitehall buildings it is proposed to construct a roof of solid concrete to resist small incendiary bombs and some resistance to penetration of high explosive bombs generally. The solid concrete floors would offer further resistance to bombs which penetrated the roof, while the second floor below the roof would be strongly reinforced to retain debris if the top floors collapsed. A strongly reinforced floor would also be provided on the ground floor level to provide protection for staff collected in the emergency refuge accommodation in the basement. Interesting to scientific workers as are these details of Government plans, they will equally welcome Sir Samuel Hoare's frank admission of the limitations of air raid precautions and his reminder that the very precautions proposed run counter to the ideals and chief movements developed in civilized life after generations of progress. In protective clothing, lighting, evacuation, we are setting the clock back for generations, and Sir Samuel Hoare averred the Government's determination to lose no opportunity of trying to reintroduce sanity into the world and remove the conditions which have made such provisions inevitable.

Administration and the Aborigines of Australia

CORROBORATION in part of recent criticism of the treatment of the Australian aborigines (see p. 1029 of this issue of NATURE) comes from a source carrying a weight that cannot be disputed. Dr. Donald Thomson, an anthropologist appointed by the Federal Government to act as a special patrol officer in Arnhem Land, now relinquishing his post to take up a Rockefeller Foundation fellowship at Cambridge, has made a statement, according to the Canberra correspondent of *The Times* in the issue of December 9, in which he comments severely on the policy in aboriginal administration being pursued in the Northern Territories. His criticism, as reported, is directed mainly against encroachment on native lands. In the selection of Groote Eylandt as a flying-boat base, he maintains, every interest but that of the aborigines has been considered. It seals the doom of a tribe of three hundred aborigines, "in many ways the pick of the surviving Australian tribes"—a view which anthropologists conversant

with the Australian material will endorse. He went on to state that the Arnhem Land Reservation is no reservation at all. It is being encroached upon in many ways, the natives are diminishing rapidly, while two watering places for pearlers, which have been established on the coast, are destined to be 'plague spots' which will extend throughout the reserve. That criticism is not entirely ill-directed has been admitted by Mr. Lyons, the Prime Minister, who, while deprecating exaggeration, concedes that there is room for improvement—indeed that improvement is "imperative and urgent". He announces his intention of calling an early conference of Federal and State representatives to consider the future of the aborigines.

Mr. G. O. Harrison

MANY graduates of the University of Birmingham will be interested to learn that Mr. G. O. Harrison, chief workshop assistant in the Physics Department, is retiring after nearly fifty years service. Mr. Harrison began as laboratory boy to Prof. J. H. Poynting when the latter was engaged on his gravitational experiments at Mason College. When Röntgen discovered X-rays, Mr. Harrison, on the instructions of Prof. Poynting, made the first X-ray tube constructed in the Birmingham district and successfully used it to make a radiogram of Poynting's hand. For the next two years, the Physics Department, with Mr. Harrison as radiographer, became a centre to which the hospitals of the city sent patients to be 'X-rayed', the well-known surgeon Jordan Lloyd being one of the first to avail himself of the new facility for seeing the 'insides' of his patients. The rays were also applied to dentistry, the method employed being very like that in general use to-day. In the course of this work, Mr. Harrison discovered that X-rays could be seen, that is, that they produced on the retina (suitably prepared by darkness) the effect of light, shadows of interposed metal objects being clearly distinguishable. This formed the subject of a letter to *NATURE* (July 15, 1897, p. 248). Mr. Harrison's skill as a glass-blower and his versatility as an instrument maker have been of great value to a long series of research workers in the Physics Department, whose good wishes will go with him in his retirement.

New Surgical Research Laboratories

THE Bernhard Baron Laboratories of the Royal College of Surgeons of England were opened by the Earl of Athlone on December 8. These laboratories, which occupy the fourth, fifth and sixth floors of the main College building, were made possible by a gift of £30,000 from the Bernhard Baron Trust. The object of the laboratories is to provide facilities for experimental work on problems bearing on surgical diagnosis and treatment and for the investigation by experimental methods of more fundamental biological problems. In addition to six large laboratories, the research unit is provided with complete animal accommodation, a fully equipped operating theatre, X-ray and photographic rooms and a pathological laboratory. The laboratories are furnished with

movable units, which allow of the remodelling of the laboratories to suit the individual requirements of those who use them. One of the most interesting features is the use which has been made in the building of Empire timber for furnishing, flooring, etc. Ample provision is made for twenty research workers, and the staff accommodation is well arranged on the sixth floor, which leaves the floor below a complete research unit. Pathological, X-ray and photographic rooms are on the fourth floor. The detailed equipment of the research rooms is interesting. Use is made of gas plugs instead of gas taps, electric power and light outlets are grouped in such a way as to facilitate the assembly of electrical equipment for experimental work. The operating theatre has been designed as a model theatre for animal work, and is completely equipped with modern steam sterilizing plant, X-ray viewing screens, diathermy and telephone installation.

Visual Purple and Vision

DR. R. J. LYTHGOE delivered the Thomas Young Oration of the Physical Society, entitled "The Structure of the Retina and the Role of its Visual Purple", on December 9. The key to the understanding of the processes by which the energy of a light wave causes impulses in the optic nerve lies in the retina. It is found that about 400 rods of the retina must be served by one nerve fibre after the demands of the cones, the organs for visual acuity, have been satisfied. The conger and other deep-sea fishes have retinæ almost exclusively composed of rods, and these rods are fine and filamentous. The fineness of the rods in the conger's retina cannot result in a higher resolving power of its eye, since some 1,600 rods must be attached to one nerve fibre. It is suggested that visual purple, the light-sensitive substance found in the rods, is adsorbed on their surfaces and that the large number of rods in the conger, by increasing the quantity of visual purple, improves the animal's vision at low illuminations. The increase in visual purple will not have a great effect on animals living at very great depths where only a narrow band of wave-lengths is transmitted. Deep-sea fishes also improve their vision at low illuminations in other ways, namely, by having large aperture eyes and also by the movements of pigment which protect the rods and their visual purple during exposure to light. The eyes of the monkeys have been shown to possess a remarkable adaptation to habit, day-hunting species having a cone type of retina, night-hunting forms having mostly rods, whilst in addition the retina is lined with tapetum, which appears to act by reflecting light back on to the rods. Recent work on visual purple has shown that the quantum efficiency of the bleaching process is about unity, and in addition visual purple has a high extinction coefficient. The 'bleaching' of visual purple by light results in the production of a yellow substance, and there are probably other intermediate products. The presence of these coloured breakdown products in high concentration might considerably modify the perception of light of different wave-lengths.

Estuary Channels and Embankments

IN the Vernon-Harcourt Lecture delivered at the Institution of Civil Engineers on December 8, Dr. Brysson Cunningham discussed "Estuary Channels and Embankments". The two chief objects of the engineering treatment of estuaries are the regulation and improvement of the navigable channel and the protection of adjacent low-lying land from tidal inundation. From the point of view of navigation, defects arise from three main causes: (1) a shifting, unstable channel; (2) a narrow bed, with inadequate depth of water; and (3) a bar. In carrying out estuary training works for the removal or amelioration of the first defect, certain principles have to be observed in order to avoid risks and possibilities involved in the confinement of the stream within a definite course. The design of different types of wall was considered by Dr. Cunningham. As regards shallowness of the river bed, the principal remedy, although not of a permanent nature, is dredging by means of floating plant of various types. The cause and origin of bars were next discussed, and the peculiar conditions attached to dredging operations in exposed situations were set out with particulars of some of the latest and largest dredgers engaged on that class of work. Dealing with estuary embankments, Dr. Cunningham pointed out that in the case of the Thames alone, there are more than 40,000 acres of serviceable marshland, utilized for a variety of purposes, which have to be protected at high water in this way, while, in the maritime provinces of Holland, whole districts lie so low as to be permanently below sea-level. The embankments on the Thames, the Trent and at the mouths of the Schelde and the Maas were illustrated and the nature of their construction explained, including the design of sluices for dealing with the drainage of inland water.

Television on a Large Screen

ACCORDING to reports in *The Times* of December 8 and 10, two demonstrations have been given recently of the reproduction of the London television programmes on a large screen. In the first case, Mr. J. L. Baird showed the B.B.C. television programme on a large cinema screen. The receiver utilized a cathode ray tube, on the luminescent screen of which a small picture, 2 in. square, was first formed. This was then projected optically on to the large screen to give a picture about 8 ft. by 6 ft. At all times the picture, it is stated, was quite clear as viewed from both the front and the back of the theatre; the focus was good and there was never sufficient interference to disturb the enjoyment of the audience. The second demonstration was given by Messrs. Scophony Ltd., using the pioneer optico-mechanical methods developed by that company. In this case, two receivers were available, one giving a screen picture 6 ft. by 5 ft. suitable for a medium-size hall, and the other being a home receiver providing a picture 2 ft. square. The first receiver was demonstrated to a large audience, who saw a very acceptable reproduction of the afternoon television programme. The pictures were free from flicker and were bright

enough to be seen in comfort by everyone present. It seems likely that these two demonstrations will mark a new stage in the progress of the technique of television reproduction.

Thermionic Valve Data

THE modern thermionic valve has now become of world-wide importance, not only in connexion with radio broadcasting, but also in its many applications in scientific and commercial instruments, and in industrial processes. Unfortunately for those who have to make constant use of valves of the usual receiving type, their popularity and rapid advances during the past decade have resulted in a multifarious range of valves for different purposes. In spite of several earnest attempts, no satisfactory means of classifying these valves has been standardized, and the various manufacturers have accordingly adopted different and arbitrary codes for designating the types of valves which they supply. Amidst this confusion and in the absence of adequate co-operation between manufacturers in different countries, it is natural to find that the number of types is constantly increasing and is now quite unnecessarily large. Pending the time when more uniformity is arrived at, however, the *Wireless World* has been fulfilling a useful public service for the past ten years by issuing a list of valve types with the appropriate technical data. A search through these lists reveals in a striking manner not only the growth in the number of valves, but also the increasing amount of information which is needed about a valve in order to select a suitable type for any purpose. The issue of the *Wireless World* of November 25 contains the latest of these lists in the form of a nineteen-page supplement. The data here provided cover more than 900 current valve types, both British and American, as many as fourteen numerical characteristics being given for some of the valves. A useful guide to valve bases is also provided. Such a publication cannot fail to be of great utility to all scientific and technical workers who make use of the modern thermionic valve.

Accessions to the British Museum (Bloomsbury)

AMONG the accessions to the collections of the British Museum (Bloomsbury) announced in December are a number of antiquities from the Near East and Egypt. Of these, among the more noteworthy are those obtained by Mr. M. E. L. Mallowan's excavations of last season on sites in northern Syria. Clay tablets from Chagar Bazar, dating from about 2000-1900 B.C., deal with accounts, mostly relating to corn. Although the names of the months are Babylonian, the tablets appear to indicate that the district was then under the dominion of Assyria. Objects from another site, Brak, are of considerable importance in the prehistory of western Asia, as they include black-on-white pottery, similar to that found by Sir Leonard Woolley at Atchana near the mouth of the Orontes, and bearing out his conclusion as to the international importance of that region as an emporium linking the Mediterranean and the

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NATURE

SUPPLEMENT

No. 3555

SATURDAY, DECEMBER 18, 1937

Vol. 140

Further Tributes to the late Lord Rutherford

Prof. Stefan Meyer

Institute of Radium Research, Vienna

THE world is poorer through the passing away of its leader in radioactivity and nuclear physics, Lord Rutherford, who was a unique personality, and what every single one of us has lost scientifically and personally is impossible to say in words. But asked to add a personal contribution to the tribute in NATURE, I am glad to be allowed to tell how much he was admired and loved in Austria.

Schweidler's and my first contact with him dates from the beginnings of radioactivity, when he was in Montreal. The deflection of Becquerel rays by a magnetic field, discovered in Vienna in 1899, was one of the foundations for his classification of these rays, and led to a correspondence that was never interrupted. We remember with pleasure his congratulations when a few years later we succeeded in proving the identity of the long-lived induced radioactivity with radio-lead and polonium as he had predicted. Our first personal meeting was in 1910, at the Congress of Radiology in Brussels. There, international co-operation in radioactivity was inaugurated and the International Radium Standards Committee set up, the members being B. B. Boltwood, M. Curie, A. Debierne, A. S. Eve, H. Geitel, O. Hahn, St. Meyer, E. Rutherford, E. Schweidler and F. Soddy. This Committee, which after the death of H. Geitel, B. B. Boltwood and M. Curie, and after F. Soddy's resignation, with H. Geiger, S. C. Lind, J. Chadwick, I. Curie-Joliot, J. Joliot, O. Hönigsmid and A. Piccard as respective successors,

survived all troubles of the Great War and the following years, and Rutherford always expressed his conviction that the Committee ought to continue. He was president of the Committee, and so late as April 1937 he signed two certificates for the new Washington standards. The first consequence of the constitution of the Committee was a meeting in Paris in 1912, which was attended by M. Curie, A. Debierne, O. Hahn, St. Meyer, E. Rutherford, E. Schweidler and F. Soddy. There, quite pure radium preparations, obtained from Paris and Vienna, were compared and the primary standards designated, a fact as important for radioactivity as the creation of the standards of the metre and kilogram.

In the summer of 1913, Rutherford, accompanied by his wife and B. B. Boltwood, visited me in Bad Ischl, where also Hönigsmid, Mache and Schweidler from Vienna had assembled. I think it was his only stay in Austria, and he enjoyed the country and the people on his trips in his car. The 'Dirndl' costumes in Ischl, which caused his chauffeur to ask what race lived in Austria, and a Tyrolese hat Boltwood bought and wore continually, were a source of unending amusement for him. At that time we wanted to organize a radiological congress in Vienna for 1915. The War prevented the realization of this plan, but it could not loosen the friendly relations between Lord Rutherford and Viennese physicists. In the same way as at that time R. W. Lawson was enabled to continue his work at the Vienna Radium Institute, Rutherford did his best to procure concessions for our compatriots in England.

The Vienna Academy of Sciences can be proud of having appreciated at an early date Rutherford's exceptional genius. The Academy so early as 1908 helped him in his work by the loan of 300 mgm. radium free of cost. In 1912 he was made corresponding member, and in 1928 honorary member. After the War it seemed as though the radium preparations still in the possession of Rutherford would be confiscated as 'enemy property'. After prolonged correspondence, Rutherford got the preparations released (1921). In 1927, when the financial difficulties of the Vienna institutes were at their climax, he bought the radium and so enabled research in Vienna to be carried on for some time. Already in 1921 he had written to me: "There seems a growing sense in our governors that it is about time they tried to help all countries to get on their feet again"; and in 1927 he wrote: "I am very sensible of the generosity shown by the Vienna Academy of Sciences and the Austrian Government in loaning me such a valuable preparation for such a long period. The use of the material has rendered possible the long series of investigations in Radioactivity by myself and my students and has been an invaluable aid in my researches". Again, when he had bought the preparation, he said: "I hope in this way to show my appreciation of the generosity of the Vienna Academy and also to help the Radium Institute to continue its radioactive investigations".

I saw Lord Rutherford for the last time in 1932 in full vitality in Münster, where the whole session of the Bunsen Gesellschaft was under the spell of his personality. In the following years he received my daughter and my son in the kindest manner in Cambridge, in spite of the numerous claims on his time, and gave them many proofs of his friendly feelings. Whoever came in close contact with him will cherish the memory of how he attracted all, not only through his surpassing scientific greatness, but also through his human kindness and personal charm.

Prof. A. Norman Shaw

McGill University, Montreal*

MEN of science the world over are mourning the death of Lord Rutherford, one of the greatest discoverers of all time.

McGill graduates are feeling an additional personal loss. His former students have for long been

*From a message printed in the *McGill Graduate Bulletin*.

proud to recall that they received training and inspiration from the greatest of all McGill professors. The fact that Rutherford laid the foundations of his major work when here has lent an added prestige to McGill University throughout the world, and created an unending stimulus for his successors. At McGill he was given his first opportunity for leadership in research, and the degrees we gave him marked more truly the graduation of McGill under his influence with a new and higher degree of science.

Rutherford was responsible for the greatest outburst of original investigation which has occurred in Canada. For several years brilliant scientific papers on discoveries in radioactivity and atomic physics poured out at the rate of nearly one a month from the able group which had gathered around him from centres as far apart as Poland, Germany, France, England and the United States. The influence of his work and ideals soon penetrated into all walks of science in Canada, increasing the demand for higher scientific training and investigation.

Old friends and pupils of Rutherford have memories even more deeply cherished than the recollections of his work itself. His lively humour, boyish zeal, and kindly human interest in the affairs of those around him, his untiring help in time of need, that remarkable driving ability by which he could obtain almost incessant work willingly given, his uncanny and unerring instinct for the next best step, his hatred of pretence and untested generalization, his outspoken frankness, his uniform fair dealing, his capacity to pick able men and later place them in their life's work, his friendliness and approachability, his dominating voice and personality when deeply stirred—these attributes and more will be recalled as hall-marks of one man, Ernest Rutherford. In our lifetime we shall not see his like again.

Prof. Niels Bohr, For.Mem.R.S.

University of Copenhagen

I AM thankful for the invitation of the Editor of NATURE to write a few words about my relations with Lord Rutherford that have been so decisive for my work and have filled so large a place in my life. Indeed, neither in the short article about Rutherford's relationship to his pupils, which I had the pleasure of contributing to the Cavendish Laboratory Supplement to NATURE of December 19,

1926, nor in the short tribute to Rutherford's memory, which I had the sad duty of giving at the Galvani Congress on the announcement of his untimely death and which appeared in NATURE of October 30, 1937, did I find opportunity to give a proper expression of my personal indebtedness to him, who was to me everything that an inspiring leader and a fatherly friend could be.

From the moment I was admitted into the group of students from very different parts of the world working under Rutherford's guidance in his laboratory in Manchester, he has to me appeared as the very incarnation of the spirit of research. Respect and admiration are words too poor to describe the way his pupils regarded the man whose discoveries were the basis of the whole development in which they were enthusiastically striving to partake. What we felt was rather a boundless trust in the soundness of his judgment, which, animated with his cheerfulness and good will, was the fertile soil from which even the smallest germ in our minds drew its force to grow and flourish. His simplicity and disregard of all external appearance perhaps never disclosed themselves more spontaneously than in discussions with his students, who were through his straightforwardness even tempted in youthful eagerness to forget with whom they were talking until, by some small remark, the point of which they often first fully understood after they had left him, they were reminded of the power and penetration of his insight.

The stimulus Rutherford gave his pupils was, however, in no way limited to times of daily intercourse. Thus when, returned to Denmark, I pursued the line of work which I had taken up in Manchester, it was to me a most encouraging feeling to know that I could always count on his warm interest and invaluable advice. Indeed, looking through our correspondence from those days, I can hardly realize how in the midst of all his work he could find time and patience to answer in the kindest and most understanding way any letter with which a young man dared to augment his troubles. Especially close our relations became during my stay for the first years of the Great War as lecturer in Manchester and when, in times full of anxieties, he kept up the spirits of the small group left in the laboratory and, in the short moments of leisure from the great practical duties entrusted upon him, steadily went on preparing the road to new discoveries which should soon lead to such great results.

In later years, it was each time to me the greatest source of renewed encouragement to visit him in his home in Cambridge, where, in spite of never-ceasing work and an ever heavier burden of duties, he shared so quiet and simple a life with the companion who, always in contact with what was deepest in his character, from early days stood by him in every joy and sorrow. With age the vigour of his spirit did not abate, but found outlet in ever new ways, and his genial understanding and sympathy with all honest human endeavour gave to his advice in any scientific or practical matter a value treasured in wider and wider circles. To every one of us to whom he extended his staunch and faithful friendship an approving smile or a humorous admonition from him was enough to warm our hearts, and for the rest of our lives the thought of him will remain to inspire and guide us.

Prof. G. Hevesy

University of Copenhagen

WHEN, early in 1911, I had the privilege of joining the Langworthy Laboratory of Physics in the University of Manchester, that part of radioactivity which may be called the classical one was approaching completion. The sequence in the three series of disintegrations and the life-period of their members had with but few exceptions been already ascertained, mainly by the work of Rutherford and his pupils. This very laborious task, often requiring for its performance much ingenuity, was initiated by the theory of successive transformations put forward by Rutherford and Soddy in 1902; this proved to be the fundamental theory of radioactive research. The successful completion of the main task of classical radioactive research further enhanced the great authority of the leader of the Laboratory and the spirit of contentment prevailing in the Laboratory.

The chapter on the properties of the radioactive radiation, though greatly advanced in those years, was far from being complete. Rutherford, although he personally carried out experiments on the heating effect of radium and its emanation with the assistance of his faithful and able laboratory steward, Kay, and encouraged all the numerous researches going on in his laboratory, concentrated his interest chiefly on the experiments on α -particles. Of all Rutherford's spiritual children, none was more deeply loved by

him than the α -particle, and none requited his affection more generously. The conception of the nuclear atom was put forward by him on the basis of the experimental results on the scattering of the α -particles obtained by Geiger and Marsden. In witnessing the birth of this conception, his pupils had a unique opportunity of seeing the working of Rutherford's great mind. To be struck by the remarkable behaviour of a tiny percentage of the α -particles investigated, to ascertain that the observed effect was genuine, to ask for a reason which would account for the effect and to accept the most straightforward solution, was a typical sequence of the truly 'Rutherfordian' way of picking out and solving problems.

In a recent speech at Guildhall, Lord Baldwin characterized his fellow countrymen as being profoundly distrustful of the men called clever. To some extent the late Lord Rutherford shared this feeling by distrusting those who wanted to build up science on purely deductive lines. He was fully convinced that the line of advance followed by him so successfully, based on the application of sound common-sense considerations to experimental observation of the right phenomena, is the most trustworthy road to progress. This deep conviction did not prevent him, however, from early recognizing the fundamental importance of ideas moving largely on deductive lines, put forward by a young man joining the Manchester Laboratory shortly after the introduction of the conception of the nuclear atom. The union of Rutherford's nuclear concept with Bohr's ideas proved to be an immensely fruitful one, the importance of which even far exceeded Rutherford's early expectations. When some time after the birth of the nuclear conception, I asked Rutherford, during conversation in his hospitable house, if the origin of the β -particles accompanying radioactive disintegration is to be traced to the nucleus or not, he answered that he did not know, and suggested approaching Bohr with this question, thus showing the great appreciation of Bohr's insight in atomic processes he already had in these days.

In later years, when Rutherford spoke of the old Manchester days, he repeatedly remarked that we did not then fully realize what great times we were witnessing. Those Manchester days were the greatest period of Rutherford's scientific genius. With increasing age and still further increasing fame, Rutherford's great and kindly interest in his former and present pupils, his deep

and sympathetic understanding of the difficulties experienced by them and mankind in general, have grown in like measure. For those who had the privilege of knowing intimately the personality and achievements of Rutherford, his death removes one of the great attractions of life.

M. le Duc de Broglie

Paris

I FEEL it a great honour that I have met Lord Rutherford of Nelson so frequently and that, only a few years ago, I was called upon to write, in NATURE of May 7, 1932, an appreciation of the great services which he has rendered to science. Now that we have lost him, we can see more clearly the magnitude of the part he has played during the past forty years in creating, to a great extent, the physics of the atom and of the nucleus.

One could give striking examples of the way in which he concentrated on the fundamental implications of any hypothesis which he adopted, and followed their consequences to the point where he was able to show clearly the need for the introduction of new ideas.

He, and the physicists of his school, probed the atom with swiftly moving electrified particles, and interpreted their results by means of the equations of classical mechanics. They were thus able to show the existence and the smallness of a central, heavy, positively charged nucleus, in the neighbourhood of which the ordinary laws of electrostatics begin to break down and to reveal new phenomena.

Bohr showed how classical mechanics must be modified to give rise to the atomic model which bears the names of Lord Rutherford and himself, and has recently emphasized the fundamental difference between interactions inside and outside the nucleus. In the first case, spheres of action encroach upon each other to such an extent that a particle cannot make contact with this region without affecting simultaneously all the parts which compose it. On the other hand, outside the nucleus, considerations proper to a two-body problem are still applicable.

In a more general fashion, the extraordinarily brilliant way in which the Cambridge school, led by Lord Rutherford, made use of formal mechanical models of the atom led to such progress in the knowledge and description of phenomena that physicists changed their outlook after the manner

of explorers who, on the far side of a mountain range, discover a new country. It then became clear that concrete images and quasi-classical theories had been pushed to the extreme limits of their usefulness and that, to make further progress, it would be necessary to introduce new ideas. Thus Rutherford's name is honoured equally by those physicists who regret the passing of the old mechanical theories of the atom and by those who prefer the more abstract ideas which have replaced them.

The great man of science whose ashes now rest in Westminster Abbey close to his illustrious predecessors was taken from us at a time when the tremendous advances in nuclear physics were giving to his work the fullness it deserved, and, in the future, they will testify to the vigour and fertility of his genius.

Prof. J. Stark

President of the Physikalisch-Technischen
Reichanstalt, Berlin

I AM glad of the opportunity afforded by the Editor of NATURE to write a few words about the late Lord Rutherford. I have admired Rutherford for the last thirty years, as one of the greatest research workers in the field of physics. When, in 1902, his fundamental publications on the transmutation of radio-elements appeared, I was so charmed by the clearness and elegance of his experimental demonstration and by the importance of his discovery that I wrote him an enthusiastic letter to Montreal and congratulated him on his discovery. For this discovery, Rutherford received the Nobel Prize in Chemistry. But he afterwards made more discoveries, chiefly of a physical character, which merited the Nobel Prize in Physics. I have therefore proposed several times to the Nobel Committee for Physics that Lord Rutherford should be distinguished by the award of the Nobel Prize in Physics also.

It is unnecessary to speak of the importance of Rutherford's discoveries for the development of research in atomic structure, for they belong already to the generally known fundamentals of atomistic research and will always be valid. Rutherford's was the spirit of a great man of science, who, basing his conceptions on reality, tries to solve great problems by watching and carrying out suitable experiments and careful

measurements, and is not influenced by dogmatic theories. If future generations choose Rutherford as a model, physics will not become numbed by learned knowledge and dogmatic formulæ, but will achieve results through practical experimentation.

Prof. Otto Hahn

Kaiser Wilhelm-Institut für Chemie, Berlin

AT the request of the Editor of NATURE I gladly write a few lines in memory of my never-to-be-forgotten professor, Lord Rutherford.

In the autumn of 1905, I went to work with Prof. Rutherford in the Macdonald Physics Building at Montreal, and this visit was primarily responsible for my decision to change over from organic chemistry to radioactivity.

In addition to other problems, Rutherford was at that time working on the magnetic and electric deflections of α -rays, which he had recognized as helium atoms. A large variety of transformation products was investigated in the course of time, and I was fortunate in being invited to take part in some of this work. We determined the magnetic and electrostatic deflections of the α -rays from radiothorium, a substance which, by a stroke of good fortune, I had discovered shortly before in Ramsay's laboratory. The apparatus was fitted up in a dark cellar. The Toepler pump functioned slowly and not always satisfactorily, and many photographs had to be taken, for there was a very real danger of radioactive contamination. Rutherford was not to be discouraged by initial failure, however, and he was able to establish conclusively that the α -rays from radiothorium and from its transformation products are also helium particles.

Nothing could deviate him from his infective enthusiasm for work, which was imparted to all the members of his institute. Of these, apart from my German friend Max Levin from Göttingen, I should mention in particular Dr. A. S. Eve, who was later appointed successor to Rutherford in the Macdonald Physics Building. I recall with gratitude the never failing fatherly friendship and readiness to help which Rutherford showed towards us two foreigners. Love of our professor and of our work formed a bond of union also with the other members of the research department, H. L. Bronson, R. K. McClung and R. W. Boyle; it was the link in our happy family circle.

All gatherings, whether of a scientific or of a social nature, bore the mark of Rutherford's outstanding personality, although he was then barely thirty-four years old. There was a combined physical and chemical colloquium at Montreal, and it happened not infrequently that the beloved α -particles slyly found their way into the discussion which followed a lecture on one or another problem of organic chemistry. Quite unintentionally, but nevertheless to everyone's joy, the most topical problems of radioactivity had again suddenly become the focus of the conversation.

At the same time, Rutherford was so sincere and unassuming in his dealings with his students and with the everyday things of life, that we two Germans in particular were constantly filled with surprise and admiration. We had no doubt imagined that such a distinguished professor would be an unapproachable person, conscious of his dignity. Nothing could have been further from the truth. I still possess a small photograph which shows him clearing away the snow from the entrance to his house. In this house we were often evening guests, listening in rapt attention to the intimate piano-playing of Mrs. Rutherford or to the spirited narrative of the Professor.

Early in the year 1906, a photographer came to the Macdonald Physics Building to take a photograph of Rutherford working in his laboratory, for publication in the columns of NATURE with an article by Dr. A. S. Eve on the Macdonald Physics Building. Rutherford was at first reluctant, but later he granted the photographer permission to take a few flash-light photographs showing him seated at his α -ray apparatus. The photographs were duly taken, and they were also quite good. In the opinion of the photographer, however, the already famous professor was not dressed elegantly enough for the readers of NATURE. Not even cuffs were to be seen peeping from the sleeves of his coat! But the photographer found a way out; I was to lend Rutherford my loose cuffs. They were so arranged that they protruded well beyond the ends of his sleeves. The photographer expressed satisfaction with the new photograph. As a result, in one of the volumes of NATURE for the year 1906 (NATURE, 74, 273), we see not only Prof. Rutherford seated alongside the apparatus with which he carried out his epoch-making experiments on the α -rays, but also one of the cuffs of a young research student, who treasures his sojourn with one of the greatest masters of physical research as one of the most beautiful memories of his life.

Prof. E. Fermi

University of Rome

THE unexpected news of Lord Rutherford's death reached me at Bologna, when I was taking part in a meeting for the bicentennial celebration of Galvani's birth. A large group of physicists from all nations were assembled there, and it was quite apparent how deeply everybody felt the loss that science had suffered, by the passing away of a man whose efforts had opened up to physics one of the widest and as yet unfathomable fields of investigation.

Lord Rutherford certainly belonged to that highest class of experimenters—very few in the history of human thought—who appear to their admirers to be led by some sort of instinct always towards the successful attack of fundamental problems. If we consider most of his experiments, we are impressed by the fact that they are conceived so simply as to be easily understood and appreciated by a layman; their performance does not require a complicated piece of machinery, nor even often exceptional experimental skill. But it is not exaggeration to state that such simple experiments, as for example the discovery of the positive nucleus inside its cloud of electrons, or the method for producing artificial disintegrations by α -particle bombardment, are milestones in our knowledge of Nature.

Lord Rutherford will be remembered in the history of science not only on account of his personal contributions but also as a teacher, in the highest meaning of this word. One of the largest and most successful groups of investigators developed around him and learned from him not only the principles and the methods of research, but also the necessity of endurance and steadiness as essential requirements of the man of science.

Prof. L. Wertenstein

Free University of Poland, Warsaw

I THINK that the concluding remark of Prof. Chadwick's tribute to the memory of Lord Rutherford in NATURE of October 30, p. 751: "we lost . . . our leader" can be applied not only to his immediate collaborators but also to those who, like myself, have worked on radioactivity and have followed for years the progress of his work.

Although in the science of radioactivity most was done by Rutherford and his school, he is also responsible for a great part of what has been done elsewhere, because he opened up new fields of research and stimulated enthusiasm to such a high degree that it was impossible not to try to attain something approaching his splendid achievements. Every branch of physics has had leading men at different epochs, but we workers in radioactivity have been exceptionally fortunate in having such a leader.

I remember, when a young student in Mme. Curie's laboratory, the impression created by the appearance of every new paper of Rutherford's in the *Philosophical Magazine*. I would say, and many of my colleagues will believe me, these papers were considerable events in my life. A young scientific worker aims at perfection and looks for some ideal to follow: this perfection, this ideal, was to be found in Rutherford's way of showing simplicity in what seemed intricate, of attaining with apparent ease what was thought unattainable, of putting aside every obstacle as if it were merely a shadow. The uprolling of the magnificent film: "the α -particle", with the thin-walled tube and electrical counting, the crystal analysis of the γ -rays, it was more than science; it was an immediate contact with Nature, as if radioactivity itself chose him to unravel its secrets. We followed and admired him, but he took at times steps too large for us ordinary mortals, and when the paper on the nuclear atom appeared most of us could not believe it. I remember it gave me many sleepless nights, and I envy Chadwick for having listened to its first announcement; was it not the greatest day in the history of modern physics?

To have Rutherford's approval of one's work was a high reward for any worker in the domain of radioactivity. When Danysz focused the magnetic spectrum of β -rays, when Rosenblum discovered the fine structure of α -rays, what an immense joy it was for them to receive Rutherford's letters of congratulation. If such was the effect of his written word, no wonder so many wished to get nearer to him.

Although I occasionally saw Rutherford before the Great War, it was in 1925 that I had the opportunity of knowing him better and of working for some time in the Cavendish Laboratory. I chose for myself a small area in the enormous territory he has won for science; I was interested at that time in the physical properties of radon,

one of those emanations the nature of which as chemical elements was established by Rutherford. I was happy enough to add some minor points to this problem, but if I mention it, it is simply because this work enabled me to live in the atmosphere of the great man. It was rather outside the main line of research pursued in the Cavendish Laboratory, but I am sure Rutherford did not disapprove anyone taking up one of the favourite themes of his earlier period, and when he spoke about it, it was as if he recalled a great adventure of his life. I learned to know his attitude in science. A man of science is often a dignified, perhaps a melancholy person: seeing him one would say: "science is a difficult thing". It was not so with Rutherford: he made you feel that science is, first of all, beauty and happiness. One would quote Goethe's words, "Ihr Anblick gibt den Engeln Stärke". This strength poured from his deep voice vibrating with the joy of creation, and even his laughter, which was so often heard during discussions of the utmost importance, was deeply rooted in the sources of this happiness. He liked others to be happy too and when he knew a physicist—of any nationality—was a 'good man', he was ready to help him if necessary. The atmosphere was contagious with genius, and during my stay in Cambridge I realized what a wonderful 'climate' it was for the highly gifted men who formed Rutherford's surroundings. Only a few names can be found ranking with Rutherford, but even more unique was the association of a great man of science with collaborators like Chadwick, Blackett, Ellis, Cockcroft and many others.

Rutherford has left us, but he survives in the hearts of all students of radioactivity and nuclear physics throughout the world. We mourn him, but our eyes are turned on those who are most deeply affected. While assuring them of our sympathy, we feel that the great inheritance is in good hands.

Dr. P. Kapitza, F.R.S.

Institute for Physical Problems, Moscow

THE death of Lord Rutherford is unanimously deplored by all men of science, but especially is it felt by his numerous pupils.

Rutherford's pioneering work, which started forty years ago, has now developed into what we call the science of nuclear physics, and of this

science we can call him the creator, since most of the new ideas and discoveries in nuclear physics have been due to Rutherford or to his pupils.

In the history of science, it is difficult to find another case when an individual scientist has had such great influence on the development of science. I think this was mainly possible because Rutherford was not only a great research scientist gifted with exceptional ingenuity, enthusiasm and energy essential for pioneering work, but because he was also a great personality and teacher. His ideas and personality attracted young research students, and his abilities as a teacher helped him to let each of his pupils develop his own character.

His way of dealing with his pupils, whom he called his "boys", was most instructive; when a new research man came to him, Rutherford would first look for any originality and personality in the young man's work. Rutherford would always prefer the man to work on his own ideas rather than to have just another assistant working under his guidance. As soon as Rutherford discovered any sort of originality in his pupil, he would do everything possible to develop it to the utmost; he would encourage him in difficult moments and moments of depression, would not be exigent in case of mistakes, but on the other hand would 'put on the brakes' when the young man became too optimistic, drawing premature conclusions from an experiment not thoroughly completed. The pupil of Rutherford would very soon learn that the judgment of his professor was always very reliable and invariably to the point; especially good was Rutherford in judging what ought to be done. Once he told me how Moseley went to him, before starting a new problem, and suggested three subjects; Rutherford advised him to choose the work which led Moseley to his famous results on the relations between the wave-length of X-rays emitted by elements and their atomic numbers.

Fairness in acknowledging the originality of the work and ideas of his pupils kept a very healthy spirit in the laboratory, his personal kindness and good will to his pupils gaining the greatest affection that a pupil can have to his teacher. I worked in Rutherford's laboratory for fourteen years, first

closely under his direction and later independently, on magnetism, which was rather outside the scope of his line of work, but he continuously took interest in my doings, and to his interest, encouragement and friendship I owe a great deal in the accomplishments of my research.

Rutherford was fond of his pupils, and to have young research people was indispensable for him, not only because it gave better possibilities of working out a larger number of problems, but also because, as he often used to say, the young students kept him young. This was indeed quite true, for he kept not only young, but if I may say so, even 'boyish', to the end of his days. His enthusiasm, energy and gaiety never changed during the years I knew him, and he himself used to say that in research he always felt a young man; he had the same ambition and the same curiosity all through life, and always felt in attacking a new problem that he stood on the same footing as his research men. The young research people helped Rutherford not to age also in another respect, for with his pupils he had to keep up to date in his ideas. He was never in opposition to the new theories, which a large number of physicists of his age would never recognize or else ignore, and I never heard him speak about the "good old age" in physics, when the fundamental laws of Nature were clear and no uncertainty existed.

I cannot think of any country from which young research people did not come at some time to work in his laboratory, in Montreal, Manchester or Cambridge. During my own time in Cambridge, I can remember students working in the Cavendish not only from Great Britain and the Dominions, but also from the United States, Chile, China, Czechoslovakia, Denmark, France, Holland, Germany, India, Italy, Japan, Norway, Poland, the Soviet Union, Switzerland and other countries. Most of them now occupy professorial chairs, and some of them have gained an international reputation in science. I am certain that in all these countries there will be men of science who will sincerely mourn Rutherford's death not only as the greatest research physicist since Faraday, but also even more deeply as their teacher and friend.

interior of western Asia. Brak has also afforded from its early levels objects belonging to a Sumerian civilization of the Archaic period, revealed in this area for the first time. Among other accessions are the now famous inscriptions on potsherds from Lachish, which are deposited by the Wellcome Trustees. These inscriptions, the Lachish letters, are the earliest known example of written Hebrew, and refer to events mentioned in the Bible and relate apparently to the siege of Lachish by Nebuchadnezzar. The Egypt Exploration Society, at the instance of Dr. Alan H. Gardiner, has presented to the Museum the antiquities allotted to it from the Society's excavations on the site of Sesebi in the Egyptian Sudan, which were exhibited at the Society's rooms in July last. It will be remembered that these excavations are of special importance for the light they throw on the earlier years of Akhnaton's rule.

Introduction of Plants into British Colonies

THE Colonial Office has performed a useful service to growers and exporters of plants and also to the British Colonies, by the issue of a digest of the legislation on plant introduction in force at the end of December 1936 (London: H.M. Stationery Office, 1937; 1s. net). Introduced pests and diseases have occasionally done much damage: instances cited are 'brown hardback' (*Phytalus Smithi*), causing serious losses to the sugar planters in Mauritius; the 'wither tip' disease, largely responsible for the ruin of the lime industry in Dominica; and the 'witchbroom' disease of cacao, now causing so much havoc in Trinidad. Since then, in 1876, Malta first instituted an ordinance "to prevent the introduction of diseases affecting agricultural produce", enactments have grown in number and diversity, and there is now real need for their comprehensive survey, such as is rendered possible by this publication, with the view of gradually simplifying procedure and introducing where possible more legislative uniformity.

To this end the third Imperial Mycological Conference, held in London in 1934, urged the adoption of a uniform type of health certificate throughout the Empire; and a standard form accepted by all Colonial Governments appears in the appendix to this summary. Furthermore, the geographical grouping of some Dependencies permits a measure of common action in these matters which has great practical advantages, and the colonies of West Africa have entered into a plant exchange convention under which each Dependency enacts similar legislation. A similar convention now links the Union of South Africa, Southern Rhodesia and the Belgian Congo, to which Northern Rhodesia and Nyasaland have since become parties. Proposals have also recently been approved for a similar arrangement in respect of East African Dependencies, and the necessary legislation is under consideration. This useful summary may supply the basis upon which further common action may be based that may lighten restrictions upon trade without removing

the necessary check upon the control of distribution of disease.

Manchester Scientists' Peace Association

THE Manchester Scientists' Peace Association, which has recently been formed with the objects of co-ordinating the influence and efforts of men of science of the Manchester district in the cause of peace, and of promoting a scientific and objective attitude to peace problems, held its first public meeting in the Milton Hall, Manchester, on December 13. The meeting was addressed by Prof. H. Levy, who stressed the importance of applying scientific methods to problems involving social relationships. He asked his audience not to be frightened by the feeling that the interaction of science and society is a political issue; politics it may be, but it is none the less amenable to attack as an objective problem. The professional politician, educated as a rule in the classical tradition, is frequently unable to appreciate this, and the entry into politics of more men of scientific training is most urgently required. But whether actively engaged in politics or not, the scientific man, especially if he has brought children into the world, cannot evade the responsibility of ensuring to the best of his abilities that the powers of science are used for the benefit, and not for the destruction, of the coming generation. A general meeting of the M.S.P.A. is to be held on January 17, at which a constitution will be proposed, officers elected and a programme of activities discussed. Particulars can be obtained from the provisional honorary secretary, Mr. D. C. Henry, The University, Manchester.

Impacts of Science

IN his Streatfield Memorial Lecture on October 15, entitled "Chemical Changes and Chances", Sir Martin Forster described some of his early experiences and the development of science in his early years which not only give a vivid and happy picture of Streatfield's personality but also afford a highly suggestive glimpse of the reactions of discoveries and personalities in the same period. He recalls being assured in November 1892 that all the most important discoveries in organic chemistry had been made, and then refers briefly to the way in which Nef, Claisen, Fischer, Pope and others rapidly enlarged our ideas of valency, intramolecular change, the configuration of sugars, the Walden inversion, etc. In discussing the reactions of science on industry, Sir Martin stresses the factor of the reaction of personality to background, and the rarity of finding a brain in which chemical and commercial instincts are co-equally powerful. He endorses Mr. Cronshaw's conclusion regarding the languishing of the dyestuffs industry in Great Britain and repudiates the unjustified condemnation of the business man in which chemists sometimes too readily indulge. On the contrary, he asserts that, in his experience, business men take reasonable trouble to ascertain the facts with which they have to deal, and he cites examples of benefits which the world enjoys through their enterprise.

IN the latter part of his lecture, Sir Martin discusses a number of problems arising out of the impact of science, and makes many shrewd comments on the attitude of chemists in such matters, which should stimulate a more rational attitude and wider scientific outlook in determining the conduct of the scientific worker as a citizen. In particular, he refers to the need for a practical attitude to the question of national defence if our liberty of thought and action is not to be lost, and of the need for more practical solicitude, enlightened by wider scientific outlook with increasing inter-communal tolerance and courage, to face ugly facts if the problem of productivity and distribution is to be solved. Equality of opportunity cannot be completed without equality of reception, which the human divergences render chimerical. The development of a community is the algebraic sum of self-development by its component members, although noteworthy material and ethical advance follow mainly from the deeds and ideals of its ablest members. The pursuit of science still does not liberate us from common human failings, and Sir Martin considers that one of our most serious problems is to prevent greatly increased comfort and opportunity for amusement from robbing our young people of self-reliance and ambition. On the solution of this problem the progress and happiness of our race will depend.

The Roads of France

IN a paper on "Transport in France" presented by F. J. Wymer to the Institute of Transport on October 19, it is said that the image which generally lingers longest in the mind of an Englishman who has motored through France is a section of 'route nationale' stretching ahead of his car into the far distance, with poplar trees passing the eye on each side like the pales of a fence. The same type of road was to be found 1,700 years ago in Great Britain from Dover to London and York, from Southampton to London and Chester, and many other roads, as the system in France is, like our own, undoubtedly descended from that of the Roman Empire. In contrasting the present roads in Great Britain with those in France, it has to be remembered that no hostile force of any appreciable dimensions has landed upon the shores of Britain for nearly a thousand years; our defences have been upon the sea and so the roads were built with this end in view. Hence the roadways of England tended mainly to be local links from village to village and so in a meandering way passed through a maximum number of towns and villages. In France they were designed on a plan connecting by the most direct routes the capital with the military centres. Having such different road systems, it is interesting to note that both France and England seem to be following similar tendencies in developing their systems unlike other great European countries. In France, after the Great War it was decided, instead of concentrating upon a few selected routes, to improve the standard of the whole system just as is being done in Great Britain. In France, the roads are being modernized by widening,

by the elimination of level crossings, by the re-designing of road junctions and the provision of modern surfacing.

THE construction and upkeep of the French roads depends upon their status. The 'routes nationales' are maintained by the State and the 'routes départementales' by the departments. The smaller roads known as 'chemins vicinaux de grandes communications et d'intérêt commun' are looked after by the communes, but sometimes the departments give them financial assistance. The 'chemins vicinaux ordinaires' and the 'voies urbaines' are kept up by the communes and municipalities alone. Taking 125 francs to the pound sterling, the total sum expended annually on the construction and upkeep of the road system is nearly eight million pounds, or about one seventh of the amount expended upon the roads of Great Britain. As a whole the roads of France are on a lower standard than those of Great Britain, and it is difficult to draw a direct comparison between expenditure in different countries as 'values' and 'exchanges' are always altering. Taxes are imposed on road vehicles, and also on their fuels. The total sums collected by the French treasury from this source amount to nearly four times the annual expenditure on the roads.

Golden Gate Fair

THE completion of 'Treasure Island' in San Francisco Bay has added about 400 acres of new territory to the United States. This man-made island will be the site of the 1939 Golden Gate International Exposition. It was formally delivered to the Government by the U.S. Army Corps of Engineers, who made the reclamation on November 21. The site of the Fair is an outstanding engineering achievement. It is happily situated between the world's two largest bridges. A special feature of the Exposition will be British Empire Day, which will be celebrated on May 27, 1939. A committee headed by Mr. A. G. Charlton, the British Consul General, is making plans for the occasion. In spite of the fact that the last of the filling material within the 17,760 ft. seawall has only recently been placed in position, two million pounds' worth of building construction work is already in progress. Large concrete and steel hangars have been completed. This Pageant of the Pacific will celebrate not only the completion of the San Francisco-Oakland and Golden Gate Bridges, but also the latest developments of science and engineering skill. These will include the Halls of the Mineral Empire and of Science, the Palaces of Business Progress, including electricity and communications, and pavilions devoted to Agriculture and Homes and Gardens. A new type of architectural design which is called 'Pacific' will combine Eastern and Western styles in a harmonious way. To beautify the grounds, £300,000 will be spent on landscape gardening and horticulture. The western States jointly with California will be hosts at this Pageant of the Pacific. British Columbia has announced that she will participate. Fifteen foreign nations have

already stated their intention to take part in the Exposition. A view of the 400-acre island reclaimed from the sea in San Francisco Bay is shown in the *Electrician* of December 10.

Meteorology in the Navy

THE Admiralty has announced the re-institution of a Naval Meteorological Branch of the Hydrographic Department, a branch which was created during the Great War but was merged with the Meteorological Office in 1920 when the latter institution was taken over by the Air Ministry, and then became the Naval Division of the Meteorological Office. Capt. L. G. Garbett, who has been its superintendent, is to be the chief superintendent of the reconstituted Naval Meteorological Branch of the Hydrographic Department, under the Hydrographer of the Navy, and will be assisted by three naval officers and a civilian staff. Although the change is being made only for administrative convenience, and does not coincide with any drastic change in naval meteorological practice, the applications of meteorology to naval operations have steadily increased in recent years, especially that part of meteorology concerned with the wind structure and the physical state of the upper atmosphere, which are of such importance for flying operations. For this reason, the existence of an efficient meteorological service organized especially in accordance with naval requirements has become a matter of even greater importance than formerly. The Meteorological Office, under the Air Ministry, has also greatly extended the scope of its activities, and will remain the principal seat of meteorological learning and research.

Palestine Journal of Botany and Horticultural Science

IN 1935-36 three numbers appeared of a new journal with this title, under the editorship of Dr. H. R. Oppenheimer; the journal is published at irregular intervals; each volume contains 10-15 sheets, of 16 pages each, and is sold abroad at the rate of one shilling per sheet. Papers published deal mainly with the plants and plant problems of Palestine or with experimental work in plant physiology or horticulture. From its descriptive nature, botanical work in a new country needs a local publication medium to record observations which are, in the main, of interest to the inhabitants of the new country, though they also attract the attention—of systematists especially—of all countries. It is to be hoped that this new venture, which includes brief Hebrew summaries of the main items in the last number of the volume, may find enough supporters in Palestine and amongst those interested in systematic botany and horticulture to enable it to continue. It is announced that Dr. Israel Reichert, mycologist and plant pathologist, joins the editorial board from the publication of the second volume; this suggests that plant pathology will be more strongly represented in future numbers. The third number contains an editorial appreciation and photograph of G. Mosheyoff, assistant in plant physiology at the Hebrew University, who died at the age of twenty-

three years as the result of wounds received during the recent disturbances at the defence of the colony Koryath Anavim. The agent for the journal in Europe is W. Junk, The Hague.

Gift to University of Melbourne Medical School

THE University of Melbourne has received from the trustees of a large estate in Australia the sum of £50,000, to be held in trust and the income applied to the Medical School, and especially to raise the status of the pre-clinical chairs. The salary attached to the chairs of anatomy, physiology, pathology and bacteriology, hitherto £1,200 (Australian) a year, is to be raised to £1,700 a year, in addition to which the University pays 2½ per cent to a superannuation fund. It is hoped by this means to strengthen the scientific portion of pre-clinical education, particularly in the second and third years, thus improving the fundamental basis for the following three years of the present six-year course.

A New Species of *Sempervivum*

DR. W. B. TURRILL describes a new species of *Sempervivum* in the *Gardeners' Chronicle* of October 23. It is *S. octopodes* Turrill, and was discovered on Mt. Peristeri in north Macedonia, by Dr. R. Seligman, during an expedition with Dr. Giuseppe. A full Latin diagnosis appears in the paper, and it is encouraging to note that the variety *apetalum* promises to become a good plant for the garden. Both type and variety have been cultivated by Dr. R. S. Wale, but the variety is much more amenable to horticultural treatment than the typical species.

Official Statistics

THE Guide to Current Official Statistics of the United Kingdom for 1936 (London: H.M. Stationery Office, 1s.) has been published. It is compiled on the lines which have now become familiar. The main part of the volume is an alphabetical list of subjects with reference to the official volumes available. Secondly, there is a numerical list of publications arranged under the headings of various departments. The volume reveals the wide range of subjects upon which official statistical information is available.

Thomas-Gilchrist Basic Process

A PAPER by F. W. Harbord at the autumn meeting of the Iron and Steel Institute gives an account of the history of the Thomas-Gilchrist basic process from 1879 to the present date, from the preliminary experiments in a six-pound converter to the present-day production of ninety million tons of basic steel per year. As a contribution to the history of modern steel-making this paper is of real value.

Announcements

THE King has been pleased to appoint the following members of the medical profession engaged in public health work, both in central and local government, as honorary physicians: Sir Arthur MacNalty, chief medical officer, Ministry of Health and Board of

Education; Sir Edward Mellanby, secretary of the Medical Research Council, formerly professor of physiology in the University of London; Mr. J. H. Hebb, director-general of medical services, Ministry of Pensions; Mr. J. C. Bridge, senior medical inspector of factories, Home Office; Sir Frederick Menzies, medical officer of health and school medical officer to the London County Council; Mr. A. S. N. MacGregor, medical officer of health for Glasgow.

DR. M. C. G. ISRAELS, assistant director of the Department of Clinical Investigation and Research in the Manchester Royal Infirmary, has been appointed by the Council of the Royal Society to a Foulerton Research Fellowship. The appointment will date from January 1, 1938; and Dr. Israels proposes to carry out research on the nature and aetiology of leukaemias and allied conditions.

PROF. A. S. SPILHAUS has recently been elected a foreign member of the Royal Meteorological Society. Prof. Spilhaus is assistant professor of meteorology in New York University, and previous to this he was connected with the South African Weather Service. He has published a number of short papers which have appeared in the *Bulletin of the American Meteorological Society* during the last two or three years, all of them showing marked originality, particularly in designing meteorological apparatus.

At the Coronation Inventions Exhibition held at Sheffield and Leeds, the double award of the Founder's Silver Medal and the Institute of Patentees' Silver Medal has been made to Dr. S. C. Blacktin for his electrotor dust and smoke meter (see *NATURE*, 140, 982, Dec. 4, 1937).

MR. E. GRAHAM CLARK has been appointed secretary to the Institution of Civil Engineers in succession to the late Dr. H. H. Jeffcott.

DR. F. HEATHCOAT, lecturer in chemistry and fuel technology at the College of Technology, Rotherham, has been appointed to the post of vice-principal and head of the Chemistry Department at the Technical College, Swansea.

MR. J. C. TREVOR will read a paper entitled "Some Anthropological Considerations of Race Crossing" before the Eugenics Society in the rooms of the Royal Society, Burlington House, London, W.1, on December 21 at 5.30. The meeting is open to the public.

A SPECIAL exhibition, illustrating the "Childhood of Animals", which will be open from December 20 until March 31, is being arranged by the Department of Zoology at the Horniman Museum, Forest Hill, S.E. The exhibition will comprise such objects as a baby koala, clinging to its mother's back; the adults, young, nests and eggs of various typical or striking species of birds; the life-history of a butterfly; and models of larvæ of the frog and a marine

worm. It is thought that Christmas, which so peculiarly belongs to the children, would be an appropriate time for the opening of such an exhibition.

THE annual Conference of the Geographical Association will be held in the London School of Economics on January 4-6, under the presidency of Prof. Patrick Abercrombie. Prof. Abercrombie will deliver his presidential address entitled "Geography, the Basis of Planning" on January 4. Further information can be obtained from the Geographical Association, c/o Municipal High School of Commerce, Princess Street, Manchester, 1.

THE twenty-fifth election of Beit fellows for scientific research will take place on or about July 8, 1938. Each fellowship is of an annual value of £240 and is tenable for two years. Fellows will be attached to a department of the Imperial College of Science and Technology. Not more than three fellowships will be awarded. Further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.7.

UNDER the terms of administration of the Clough Memorial Research Fund administered by the Edinburgh Geological Society, a sum of approximately £30 is available annually for geological research in Scotland and the counties of Northumberland, Cumberland, Durham, Westmorland and Yorkshire. Applications for grants are invited for the period April 1, 1938-March 31, 1939. Further information can be obtained from the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh.

THE following appointments and promotions have recently been made in the Colonial Service: A. P. S. Forbes, agricultural officer, Nyasaland; G. M. Gates, veterinary officer, Nigeria; G. R. Groves, horticulturist, Bermuda; F. M. Levin, meteorological assistant, British West Africa Meteorological Service, Gold Coast; W. B. Mason, inspector of plants and produce, Gold Coast; L. S. Matthews, meteorological assistant, British West Africa Meteorological Service, Nigeria; J. D. F. C. McDonald (senior plant pathologist, Kenya), director of agriculture, Cyprus; S. J. Saint (assistant director of agriculture and chemist), director of agriculture, Barbados; F. Flippance (assistant curator, Gardens Department, Straits Settlements), superintendent, Botanical and Forestry Department, Hong Kong.

ANNOUNCEMENT is made of the forthcoming publication of an "Annual Review of Physiology", in which it is proposed to review the developments of the preceding year or biennium in the major fields of physiological research. The series will appear under the auspices of the American Physiological Society, Inc., and the Annual Review of Biochemistry, Ltd. The new review will conform in general style and format to the "Annual Review of Biochemistry". Prof. J. Murray Luck, Stanford University, California, will serve as managing editor.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1066.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Origin of Yolk Lecithin

WE administered labelled (radioactive) sodium phosphate to a hen by subcutaneous injection and, after the lapse of 28 hours, removed 34 yolks from the ovary having an aggregate weight of 30.6 gm. The lecithin of each yolk was then extracted and the phosphorus content and radioactivity determined. The blood plasma, blood corpuscles and the liver were treated in a similar way. The results obtained are seen from the accompanying table, in which for sake of simplicity the specific activity (activity per mgm. P) of the blood plasma phosphatide phosphorus was taken to be 1.

SPECIFIC ACTIVITY (relative activity per mgm. P).

Extracted from	Phosphatide P	Non-phosphatide P
Plasma	1	0.83
Corpuscles	0.37	0.28
Liver (alcohol + ether extract)	1.24	1.18
Liver (ether extract)	1.22	—
Yolk, 30-100 mgm. (average)	0.044	1.44
Yolk, 690 mgm.	0.65	1.38
Yolk, 2,510 mgm.	1.18	1.48
Yolk, 4,500 mgm.	0.7	—

Before interpreting the figures obtained, we wish to recall the following facts. We found that while labelled phosphorus in sodium phosphate exchanges rapidly with the phosphorus in bone phosphate, it does not exchange with lecithin phosphate¹. Furthermore, when the labelled P is first put into the blood, 1 mgm. P will show, for example, 10,000 activity units; as a result of a rapid exchange going on chiefly between bone phosphate and the inorganic phosphate of the blood, 1 mgm. will soon correspond to less than 10,000 activity units; in the case of the hen, we found the above-mentioned activity to amount after the lapse of 28 hours only to about 10.

When doing research with labelled P we are mostly, as in the present case, interested in the quantitative determination of the amount of a phosphorus compound synthesized in the body after the administration of the labelled P. The above-mentioned rapid change in the sensibility of our indicator with time makes it, however, very difficult to obtain the result desired; a high activity of the phosphorus compound in question being quite compatible with the new formation of only a small part of the compound in question and vice versa. In the experiments discussed in this note, there can, however, be little doubt that the phosphatide molecules present in the liver of the hen were to a very large extent formed within 28 hours, that is, after the administration of the labelled P.

In experiments which we were able to carry out through the kindness of Prof. Lundgaard and Dr. Blixenkron on isolated livers of cats and in which no skeleton or other organs were present, the difficulties mentioned above do not occur. In these

experiments we found that within 2.5 hours of perfusion, about 1 per cent of the liver phosphatide gets labelled and is thus newly formed. In the living organism, the liver metabolism is certainly not less effective than in an isolated liver, and therefore there can be scarcely any doubt that within 28 hours a great part of the phosphatide molecules present in the liver was newly formed.

As the specific activity of the blood plasma and also of the yolk lecithin do not differ greatly from that of the liver lecithin, we have to conclude that the lecithin molecules present in the blood are also to a large extent newly formed within the last 28 hours. That the difference between the specific activity of the phosphatide P of the liver and yolk, as is seen in the table above, is smallest in the case of the 2,500 mgm. yolk is just what we should expect. Such a yolk is to a large extent formed² within 28 hours, while that is to a less extent the case both for smaller and larger yolks. We thus conclude that the yolk lecithin was taken up from the plasma, the plasma lecithin being replaced by molecules formed at least mainly in the liver. In the case of the hen experimented on, within 28 hours about 40 mgm. yolk lecithin P was formed, the phosphatide P present in the total plasma was 20 mgm., and that in the liver 38 mgm. The large drain on the liver P necessitated the formation of a large part of the liver phosphatide, which was synthesized from labelled blood and thus became active.

It is of interest to note that the blood corpuscle lecithin P only shows one third of the specific activity of that of the plasma lecithin P. This finally disposes of the theory according to which the place of formation of the blood lecithin is the blood corpuscles. We also carried out *in vitro* experiments in which blood was shaken for some hours with labelled sodium phosphate, and determined the amount of labelled phosphatide formed; it amounted only to 1/1,000-1/2,000 of the total phosphatide present in the blood.

Mr. A. H. W. Aten extracted the phosphatides from the organs of a hen only 5 hours after administration of the radioactive sodium phosphate. Taking the specific activity of the plasma inorganic P to be unity, the following values were obtained for the specific activity of the phosphatide P: liver 0.54, plasma 0.44, ovary 0.039, yolk, maximum 0.034, and intestine 0.11. The above figures show clearly that the liver of the laying hen is responsible for the formation of most of the phosphatides, which are then carried by the plasma into the ovary.

In an egg removed from the oviduct the yolk phosphorus was found to be scarcely active; from this we must conclude that this yolk had not grown within the previous 28 hours. The shell P of this egg showed the specific activity of the inorganic plasma P.

Some of the labelled phosphorus used in our experiments was prepared by us from sulphur under the action of neutrons emitted by a radium-beryllium mixture most kindly put at our disposal by Prof. Niels Bohr, and some of it was a generous gift from Prof. Lawrence of the University of California. We should also like to express our best thanks to Miss Hilde Levi for her assistance in this work.

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¹ Skandin, *Arch. Physiol.*, **77**, 148 (1937). The work of Artom and his colleagues (*NATURE*, **139**, 836 (1937); *Arch. internat. Physiol.*, **49**, 32, 37) is also based on the assumption that phosphatide P does not exchange.

² Comp. Gerhartz, H., *Arch. gesamt. Physiol.*, **156**, 215 (1914).

An Effect of Catastrophic Ionospheric Disturbances on Low-Frequency Radio Waves

RECENTLY there has been much interest in those catastrophic ionospheric disturbances which are supposed to produce 'radio fade-outs' on high-frequency radio waves and short-lived disturbances in the terrestrial magnetic records. In a recent report, Dellinger¹ has given an account of the results of these disturbances, based on more than a year's observations by workers in different parts of the world, and he states that "ordinarily the intensities of the waves received from radio stations on frequencies below about 1,500 kc./s. are not perceptibly affected during a fade-out". He mentions, however, that Bureau² has found an increase in the number of atmospherics on frequencies between 27 and 40 kc./s. during many of the disturbances; this is the only evidence so far published that the propagation of low-frequency waves is affected at these times.

We have been engaged, for some years, in studying the phase of the downcoming wave received at Cambridge from the low-frequency sender at Rugby (frequency 16 kc./s., distance 90 km.) by a method which has been described elsewhere³. The variation of phase of the abnormal component (that is, the component of the electric vector which is parallel to the ground) of the wave near sunset is usually observed to be of the form shown in Fig. 1. Other evidence leads us to suppose that the equivalent reflection height in the daytime is about 65 or 70 km., and that Fig. 1 represents an increase of this height by about 12 km. during sunset. On some occasions a very marked, but short-lived, disturbance in the ordinary behaviour has been noticed, an example of which is shown in Fig. 2.

On these occasions it appears that the normal sunset increase of reflection height is temporarily interrupted, and replaced by a decrease. It is of interest to investigate how far these phase anomalies at low frequencies are related to other phenomena which are supposed to be produced by catastrophic ionospheric disturbances. In an analysis of the results so far obtained, we have compared the times of occurrence of the low-frequency phase anomaly with the times of fade-outs, increases in atmospherics, and magnetic anomalies occurring on the same days. The times of fade-outs and increases of atmospherics have been taken from published data supplemented by data supplied by our colleagues in Cambridge.

The magnetic data have been taken from the published hourly mean values of the magnetic declination

observed at Abinger. A curve drawn through the hourly mean values of the declination was compared with a similar curve drawn through the monthly mean values, and the times and magnitudes of

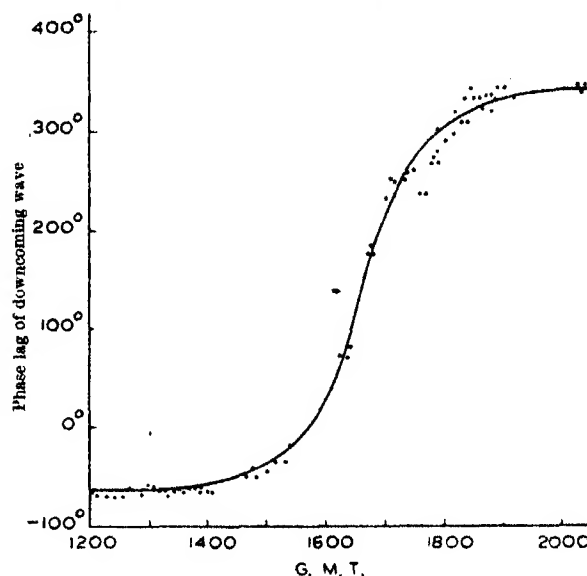


Fig. 1.
FEBRUARY 25, 1937.

magnetic anomalies were noted. A departure from the mean of more than two minutes was classed as an anomaly, since departures of magnitudes greater than this were found to be infrequent on days which showed no low-frequency anomaly.

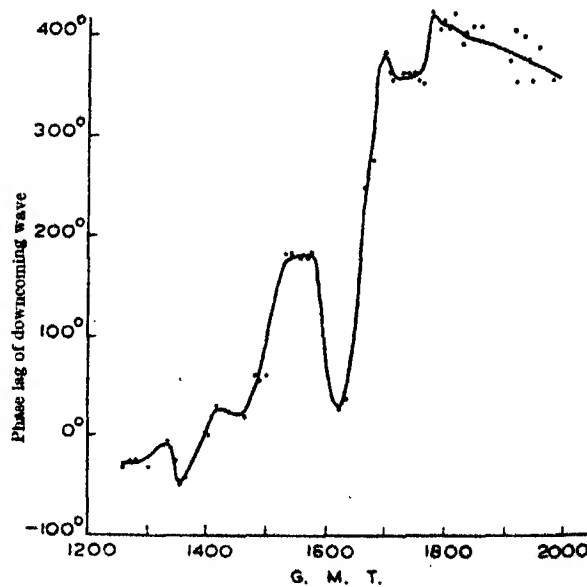


Fig. 2.
NOVEMBER 6, 1936.

Low-frequency phase anomalies were noticed on eighteen days. Of these, seven coincided with reported fade-outs, to within about a quarter of an hour. Whenever a fade-out was reported at a time when detailed observations were being made on the

low frequency, an anomaly was observed. On three occasions the low-frequency anomaly coincided with a reported increase in atmospherics observed on a frequency of 27 kc./s. On the remaining eight days no fade-out or increase of atmospherics was reported, but the low-frequency phase anomaly was associated with a magnetic anomaly, occurring within one hour of the observation.

We conclude that a catastrophic ionospheric disturbance has a marked effect at the level of reflection of the low-frequency waves (70 km.), this effect being most evident as a decrease in reflection height of the waves.

Our experiments have not shown any clear indication of a change in reflected wave amplitude at the time of the phase anomalies. The change in received amplitude of atmospherics noticed by Bureau may be the result of a change in reflection height altering the phase relation between the interfering down-coming and ground waves, or it may be due to a real change in the amplitude of the downcoming wave, which occurs in his case but not in ours, either because the reflection is much more oblique, or because the frequency of his observations is different from that of ours.

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¹ Dellinger, *Bur. Stand. J. Research*, 19, 111 (1937).

² Bureau, *Comptes rendus*, 203, 1257 (1936).

³ Best, Ratcliffe and Wilkes, *Proc. Roy. Soc., A*, 156, 614 (1937).

Effect of a Magnetic Field on the Electrodeless High-Frequency Discharge

THE following experiment, which originated from an investigation of the magnetron, seems to be of more general interest as it happens to confirm some recent theories (especially those of Prof. V. A. Bailey) on what happens to wireless waves in the upper atmosphere.

It is well known that the electrodeless high-frequency luminous discharge can be started by comparatively low voltages in a gas at very low pressures. It is only necessary to place the bulb of low-pressure gas between two plates connected across a tuned circuit coupled to a medium-power wireless generator. If the pressure is so low that the mean free path is long, any electrons present will vary in speed in unison with the voltage alternations, and if the maximum speed attained (which depends on the amplitude of this voltage) is sufficient to produce ionization by collision, a discharge may be started. It seemed likely that if instead of allowing the speed of the electrons to rise and fall they were continually accelerated a discharge would start with a much lower voltage. This can be done by applying a fixed magnetic field perpendicular to the electric force which causes the electrons to move round in orbits; the time of turning through 360° depending only on the magnetic field strength. If this strength is so adjusted that this time is equal to the periodic time of the high-frequency voltage, a sort of resonance occurs (if the free path is long enough) and the electrons move round faster and faster in orbits which get bigger and bigger. The condition for resonance is that the product of the wave-length in metres and the field in gauss should be approximately 110.

It is necessary, however, if the orbit in which ionizing speed is attained is not to be too large, so that the experiment can be conducted in a bulb of reasonable size, that a short wave be used. The following experiment was done with a 6 metre wave-length and a field of about 18 gauss. As the pressure of air in the bulb was reduced, it was found that down to pressures of about $\frac{1}{10}$ mm. of mercury, the potential required to start the discharge was unaffected by the magnetic field, but a further reduction in pressure and consequent increase in the mean free path had a most striking effect. At $\frac{1}{10}$ mm. the field reduced the starting potential by a factor of 5, at $\frac{1}{100}$ mm. by a factor of about 40, and at the lowest pressure which could be read on the gauge—something less than $\frac{1}{100}$ mm.—the discharge still started quite easily with the magnetic field on but it could not be started at all without it.

In the upper atmosphere, the magnetic field is less than 1 gauss and the wave-length for resonance is therefore much longer than the above, but there is no bulb to limit the orbit size. The electric force in a wireless wave is of course far too small to work the electrons up to ionizing speed before a collision, but the resonance results in the transfer of considerable energy from the wave to the medium, with the consequences explained by Prof. Bailey.

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Interpretation of Atomic Constitution

A WARY man hesitates to cross swords with a skilful fencer, but it is cowardly to decline to face difficulties. Colonel Moore-Brabazon might well have asked for other explanations—Why two electricities? What is the difference between the so-called positive and negative electricities? What is negative energy? Why does not the electron explode? However, he is probably prepared, like the rest of us, to accept Nature as we find it, and the paths that we follow are forced upon us rather than chosen.

It is permissible at least to emphasize the protean forms of energy which exist, for the transmutations of energy are quite remarkable. For example, work generates a proportionate quantity of heat (kinetic energy). The energy $w = Jh$, where h is in heat-units and J is Joule's constant; alter the units and state $W = H$, or energy equals heat generated.

Again, energy is proportional to mass ($w = mc^2$, where c is the velocity of light). Change the unit of mass, and energy equals mass, or $W = M$.

So, too, energy may leave an atom as a photon and $w = hf$, where f is the frequency of the wave and h is Planck's constant. With another change of units, it follows that $W = F$, or energy is frequency. Altogether it follows that energy = mass = heat = frequency!

The conservation of energy is the conservation of mass and is the conservation of frequency, and frequency may be as important as energy. But no one supposes that mass is merely a number—the first blow dispels that illusion.

Most remarkable is the fact that in certain circumstances a photon, in the shape of a high-frequency gamma ray, will materialize and give rise to an electron and a positron, so that 'light' becomes two masses, if you like, two charges, if you will, two waves, if you prefer it, but certainly two entities,

very similar in character, mass, velocity, momentum, energy, and properties in a magnetic field except for swerving opposite ways and therefore having opposite charges, whatever that may mean.

There is no reason why a neutron may not have so much electrical energy within it that its mass may be electrical: But why lay down the law about things of which at present nothing is known? There is no *credo* in science, and no one knows what force, or mass, or energy are, but they have measurable properties. Measure them and keep the balance sheets!

Electrons are used in countless valves for telephony and wireless sets—but as for defining an electron—whose job is that? A thing is known only by its properties.

The mass of an electron increases with its velocity, particularly at speeds approaching the velocity of light. This was known in theory before it was verified by experiment in pre-relativity days. Does a neutron also increase in mass with velocity? This is a difficult point involving experiments that are far from easy. Two of my Cavendish friends answer yes, the neutron will increase in mass with speed, following relativity principles.

The nucleus of an atom is a small region compared with the atom itself. The nucleus seems to be composed of those things which come out of it, such as protons, neutrons, alpha particles. But these elements when *inside* the atom may have a very different character, and the interior may be a seething collection of electrical waves, having frequency, energy, mass, which may not need to be "held together". No one knows how an electron continues to exist or why it does not violently explode. Small-scale phenomena need not resemble large-scale happenings. It is remarkable to what extent many macroscopic results do hold good in the microcosm, but it is quite certain that quantum theory is needed to explain spectra, and that everyday mechanics will not suffice for the atom and its behaviour.

Five years ago, Bohr was writing: "As soon as we inquire more closely into the constitution of even the simplest nuclei, the present formulation of quantum mechanics fails essentially . . . but it is interesting to note that the energy liberated by the formation of the nucleus, as calculated from the so-called mass-defect by means of Einstein's relation ($w = mc^2$) is in approximate agreement with the binding energy of the protons to be expected on quantum mechanics from the known nuclear dimensions".

Physicists will move on from strength to strength, astonished at their great successes in forty years. Unfortunately, only those who spend an arduous life-time in theory and research are able to appreciate fully both their achievements and their failures.

If these views have any merit it belongs to others; if any errors they are my own.

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Physiological Patterns and Mental Disturbances

THAT a diminution in the oxygen tension of the inspired air can produce mental changes is an established fact. Far less certain is the possible correlation between psychotic manifestations as seen in clinical practice and an impoverished supply of oxygen to the central nervous system. It was thought that further light might be shed on this possibility

by estimating the gaseous content of arterial blood and also of that drawn from the internal jugular vein of the same subject. In a group of patients in which the diagnosis of schizophrenia appears certain, this procedure has been carried out according to the method used by Lennox¹, and the following results were obtained:

Arterial Blood		Venous Blood		A. V. Δ		Blood O ₂ Cap.	
CO ₂	O ₂	CO ₂	O ₂	CO ₂	O ₂	R.Q.	
(64)*	(64)	(59)	(59)	(58)	(53)	(58)	(50)
50.42	17.72	57.05	11.39	6.71	6.46	1.072	19.01
49.14†	18.12	54.96	11.96	5.82	6.2	0.95	19.56

* Figures in parentheses represent number of subjects. Arterial and venous blood was withdrawn from the same subjects but in five cases one failed to enter the internal jugular; this accounts for the larger number of arterial samples.

† Figures in this line reported by Lennox¹ in non-schizophrenic subjects.

A complete report of these findings, together with those from the control group, will appear at a later date, and at that time a brief clinical summary will be given of each patient studied, thus eliminating some of the vagueness which necessarily accompanies such an indefinite and general term as 'schizophrenia'. Suffice it to say at present, that the group was a representative one in that some of the patients were of the active and paranoid type whereas others were of the catatonic variety; some were actively engaged in manual labour and others were confined in a demented state to their respective wards.

As the blood samples were being withdrawn, a spiograph was recorded on the Roth-Benedict apparatus in order to detect any temporary alterations in breathing which might affect the gaseous content of the blood examined. The marked regularity in rhythm, uniformity in depth of both inspiration and expiration, and small tidal air in the schizophrenic group before, during and after the puncture was noted in contrast to the relative irregularity of all of these features before the puncture and a marked irregularity which supervened at the time of the puncture in the control group.

Segregating the pneumographs by inspection of the tracing, the following distribution is found:

	Number of subjects	% of cases showing 'regular type' of breathing	% of cases in which spiograph was neither regular nor irregular	% of cases showing 'irregular type' of breathing
Normal	30	6.6	17.4	76
Schizophrenic	57	77.7	7.5	14.8

The cardiac output, determined by Grollman's method, has also been measured in a few of the patients and in the control group. The difficulties inherent in the technique and also entailed in obtaining the necessary co-operation of the patient have limited the number of such observations so that, as yet, they are not sufficiently extensive to be entirely representative. However, the figures at hand demonstrate a small stroke volume and cardiac index in the majority of those schizophrenics on whom cardiac determinations have been made. The catatonic individuals have a smaller stroke volume and cardiac index than the paranoid. In agreement with others, we have found the basal metabolic rate to be in general low.

All these observations have been repeated a number of times on some of the subjects from both groups. Extremely consistent findings are obtained from the schizophrenics, whereas those from the control group show a greater variability on separate occasions. It is generally more difficult to establish a strictly basal

state in a mental patient than in a normal individual, and yet, in spite of this, there is more likelihood of finding the figures for blood gases, cardiac output and respiration more nearly the same in a schizophrenic than in a member of the control group. It would seem that the schizophrenic physiology is less susceptible to change. On one occasion when a schizophrenic individual was breathing into the Roth-Benedict apparatus, he began to hyperventilate both forcefully and rapidly, keeping this up for $3\frac{1}{2}$ minutes before he could be persuaded to desist. Following the period of hyperpnoea, his respirations continued with exactly the same rhythm and uniform depth as before the onset of his voluntary hyperventilation; there was no period of apnoea and no semblance of Cheyne-Stokes' type of breathing. This set or fixed type of physiology is one which cannot readily adapt to the over-changing internal and environmental demands; it is one which would allow greater fluctuations in the *milieu interieur*.

It would appear that there is no one single physiological characteristic found in schizophrenic patients which cannot also be found in the normal population. We have found members of the control group with a very regular type of respiration, others with a small tidal air, and still others with a small cardiac output; some with a high arterial carbon dioxide or a low oxygen saturation. Still others may have a low basal metabolic rate or else a large difference in the gaseous content of arterial and internal jugular blood, or else a low blood pressure. Fewer still show the fixity of physiological processes and none, so far as we have observed, presents the combination of these phenomena to such a degree as does the schizophrenic.

It would be extremely interesting to know whether this pattern of physiological responses be present before the onset of frank psychotic manifestations, and we are at present gathering material which will decide this point. On the basis of the results obtained in a limited number of instances, one would say that this type of physiological activity is more characteristic of the individual than of his illness, and therefore precedes its appearance.

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¹ Lennox, *Arch. Neurol. and Psychiat.*, 26, 719 (1931).

Alleged Specific Effects of High-Frequency Fields on Biological Substances

VARIOUS claims for the demonstration of specific electric actions of high-frequency fields on biological substrates, that is, non-thermal effects dependent on wave-length, have already been refuted¹. Attenuation of some bacterial toxins exposed to 1.9–3.7 m. fields, under conditions which appeared to eliminate the influence of the heat developed, seemed nevertheless to indicate the existence of such an athermal action (Szymanowski and Hicks²). Subsequent negative results with different bacteria, etc., led these authors³

to suspect that their previous results might have been due to an undetected local rise of temperature, although a selective heating of small dispersed particles (bacteria, micellae, macromolecules) is improbable because of the rapid heat exchange with the medium⁴.

In these circumstances it was deemed essential to check the positive observations of Szymanowski and Hicks by exposing solutions of bacterial toxins to high-frequency fields of considerable strength under conditions which would strictly limit the rise of temperature. (Szymanowski and Hicks usually allowed a rise of average temperature to about 30° C. Since one surface only of the liquid was cooled, a steep temperature gradient was probably set up across the toxin layer.) The necessary conditions can be defined with some exactitude, and they have been embodied in two experimental arrangements: (a) the 'static' one, in which a film of liquid is enclosed between cooled condenser plates 1 mm. apart, and (b) the 'dynamic' one, in which a column of liquid of diameter 4 mm. is passed through a condenser field (each element being exposed for 0.15 sec.) and cooled during its return to the field⁵.

For the static method we can calculate the maximum rise of temperature in the centre of the film when the voltage across the plates and their temperature are kept constant⁶. With the tetanus toxin solution used in our experiments (conductivity 0.8×10^{-4} ohm⁻¹ cm.⁻¹ at 3° C.) this maximum temperature would, in the absence of convection effects, exceed the plate temperature by 0.17° C. with a potential gradient of 1000 v./cm. and by 2.54° C. with 3000 v./cm. With some simplification, the rate of heating can also be computed for the dynamic method⁷: with conductivities of 0.54×10^{-4} ohm⁻¹ cm.⁻¹ (0.1 per cent solution of tetanus toxin in distilled water) and 1.63×10^{-3} ohm⁻¹ cm.⁻¹ (1 per cent sodium chloride solution) at 20° C. the maximum rise of temperature during one passage through the field of any element of the fluid should be 0.013° and 3.8° C., respectively, for 2500 v./cm. and a wave-length of 3 m.

The value calculated for 1 per cent sodium chloride solution was confirmed experimentally by recording the resistance changes in the exposed region with an A.C. bridge and oscillograph during motion of the fluid: the average rise of temperature was 2–3° C., with a maximum variation of 0.5° C. during the slow phase of the rhythmic movement of the pump. Since the initial temperature was below 3° C., the maximum temperature of the toxin solutions in either method is far below that at which the rate of destruction of the toxin would be significantly increased.

Movement of 16 cm.³ of 0.1 per cent tetanus toxin solution for 4.5 hours at 3° C. in absence of the high-frequency field caused some attenuation, while exposure to a field of 2500 v./cm. at wave-lengths 3.1–3.4 m. produced only a slight additional effect (that is, a slight increase in the minimum lethal dose for mice). In these experiments, however, the toxin was actually exposed to the field for only 17.5 min. A 1 per cent aqueous solution of tetanus toxin kept for some hours in a thin layer between varnished metal plates or walls of Monax glass lost most of its toxicity. This destruction was just prevented by addition of 0.2 per cent of rabbit serum. After exposure of such a film (0.8 c.c.) to the field (1000 or 3000 v./cm., $\lambda = 3.1$ –3.4 m.) for 3 hours, the toxicity was exactly the same as that of the control film. A distinct specific effect, therefore, was absent. A generalization of this result would be premature

before investigations on other toxins of different properties were completed.

It may be added that, contrary to Schliephake's brief statement⁶, the viscosity of serum from defibrinated ox blood, protected from undue heating, was not altered after exposure to a 3.6 m. field. The frequency-independent effect predicted by Kraany-Ergen can be expected to occur only during exposure.

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¹ See, for example, Curtis, W. E., Dickens, F., and Evans, S. F., *NATURE*, **138**, 63 (1936).

² Szymanowski, W. T., and Hicks, R. A., *J. Infect. Dis.*, **50**, 1 (1932).

³ Hicks, R. A., and Szymanowski, W. T., *J. Infect. Dis.*, **50**, 466 (1932).

⁴ Kraany-Ergen, W., *Radiologica*, **1**, 136 (1937).

⁵ Bateman, J. B., and Rosenberg, H., Report of the Intern. Congr. for Short Waves, Vienna, 1937, p. 129. There are some misprints in the numerical values.

⁶ Schliephake, E., "Kurzwellentherapie", p. 52 (2 Ed., Jena, 1934).

Classification of Taxes and Kineses

IN recent years, the study of animal reactions to elementary physical stimuli has extended greatly, both in the laboratory and in the field. During this process, it has been necessary to modify somewhat Kühn's^{1,2} classification based on the externally observable characteristics of locomotory reactions of this kind. Recent work by Ulyott³ indicates a way in which the classification and terminology can be considerably simplified and improved.

Working on the light reactions of a planarian, *Dendrocalum lacteum*, Ulyott showed that the classical avoiding reaction⁴ can be regarded as a special case of a more generalized reaction. If *Dendrocalum* is tested in a smooth gradient of light which has no horizontal component, as it moves towards the brighter end it makes increasingly frequent turning movements; if the animal is kept in constant stronger light, the initial higher frequency of turning falls off owing to sensory adaptation. This combination of differential frequency of turning and adaptation leads to aggregation in regions of lower light intensity, provided that the gradient is of suitable steepness. This behaviour can scarcely be described as an avoiding reaction (cf. *Paramecium*, Jennings⁵). Nevertheless, the same mechanism is probably involved when the animal shows an avoiding reaction at the edge of a shadow. The terms *avoiding reaction* and *trial and error* are thus objectionable, not only because they describe a particular form of the reaction and not its general form, but also because they are not sufficiently objective. The term *phobo-taxis* is objectionable too, because the prefix *phobo-* is in common use in English, with an anthropomorphic implication, and because the reaction given this name is the only undirected one which is called a *taxis*.

We therefore propose the following modifications of the nomenclature. Variations in generalized, undirected, random locomotory activity due to variations in intensity of stimulation are *kineses*. Such variations can be of two kinds, namely, changes in linear velocity, and changes in rate of change of direction (Ulyott's *R.C.D.*) or angular velocity. We

propose to divide kineses into (a) ortho-kineses (*ὀρθός*—direct, forward)—variations in linear velocity (previously called simply *kineses*); and (b) klino-kineses (*κλίνειν*—to deviate)—variations in angular velocity. The prefix *klino-* is free from anthropomorphic implication. The whole word *klino-kinesis* can be used to describe the kind of reaction discussed by Ulyott, as well as other 'avoiding reactions' and 'phobo-taxes' which have not yet been demonstrated to be either like or unlike it in their details.

If this change is made, the word *phobo-taxis* can disappear, and the word *taxis* can be reserved for directed reactions, formerly called *topo-taxes*. This last word, therefore, also becomes unnecessary, and it is the more desirable to drop it because it is so similar to *tropo-taxis* in appearance and sound. We thus propose to add two prefixes to the nomenclature, in *ortho-kinesis* and *klino-kinesis*, and to remove two, in *phobo-taxis* and *topo-taxis*, so that the classification is clarified without becoming more cumbersome.

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¹ Kühn, A., "Die Orientierung der Tiere im Raum" (Jena, 1919).

² Fraenkel, G., *Biol. Rev.*, **6**, 36 (1931).

³ Ulyott, P., *J. Exp. Biol.*, **13**, 265 (1936).

⁴ Jennings, H. S., "Behaviour of the Lower Organisms" (London, 1906).

Variations in Copepod Development

AN interesting phenomenon has just been brought to my notice on reading a paper by Martin W. Johnson on the development stages of *Eucalanus elongatus*¹.

In a paper which I published last year², I described the early stages of this copepod from material taken off the west coast of Scotland. The two descriptions correspond very closely except in one particular, for whereas I found only five stages in the nauplius life (the earliest corresponding to other calanoid nauplii at Stage II), Johnson finds all the six stages represented. Since Gurney in the Discovery Report No. 9 (1934) finds a similar state of affairs in *Rhinocalanus* (that is, only five nauplius stages), I am led to the conclusion that with *Eucalanus* there is a difference in the development between California, where Johnson's material was obtained, and the west coast of Scotland.

In searching for an explanation of these differences, it is natural to turn to the hydrographical conditions of the areas concerned. The Eucalanids are warm-water forms and exist in the colder regions only by virtue of the warm-water currents which bring them there. In both Gurney's material and mine the specimens were taken from water of which the temperature was some 10° lower than that of the area supplying Johnson's material. It seems, therefore, not impossible that the suppression of stages in development might be correlated with temperature, and further observations in this direction should prove of interest, especially as the incubation period of the eggs of *Calanus* appears to be lengthened by

the lowering of temperature. Can it be that in the case of a warm-water copepod species breeding in unusually cool surroundings the incubation period may be so prolonged that the animal emerges from the egg in the second nauplius stage?

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¹ *Trans. Amer. Mic. Soc.*, 56, Jan. 1937.

² *Ann. Mag. Nat. Hist.*, Sept. 1936.

Effect of Spraying Solutions of Growth Substances on the Inflorescences of the Florists' Chrysanthemum

THE florists' chrysanthemum exists in many forms, two of the commonest being normal 'double' and 'incurved'. In both, the inflorescence consists entirely, or almost entirely, of ligulate flowers, but the 'incurved' type is distinguished from the normal 'double' type by the fact that in the former the corollas of the flowers constituting the mature inflorescence remain incurved. Experiments carried out here in which inflorescences of the double chrysanthemum (var. 'Gold Standard') were sprayed with solutions of two growth substances indicate that the difference between these two types of chrysanthemum may be a simple physiological one. The two growth substances used were β -indoleacetic acid (heteroauxin) and α -naphthalene acetic acid. Aqueous solutions of these growth substances of a concentration of 0.05 per cent were sprayed on to partially opened inflorescences by means of an atomiser.

In the unopened bud of the inflorescence the corolla of each flower is rolled longitudinally and folded laterally, and during opening there is a longitudinal unrolling and a lateral unfolding of the corolla of each flower. When partially opened inflorescences are sprayed in the manner described above, corollas which at the time of spraying are mature are unaffected by the treatment. Corollas which at the time of spraying are unrolling exhibit some reversal of movement and become incurved. Corollas which at the time of spraying are still rolled have their normal unrolling inhibited whilst the lateral unfolding proceeds normally and the flower becomes a typical 'incurved' one. The results are the same whether the treatment is applied to inflorescences attached to, or detached from, the parent plant.

Although these experiments have been carried out with synthetic growth substances, the resemblance between the effect of natural auxin and synthetic growth substances in other directions is so striking, that it appears possible that one of the fundamental differences between normal 'double' and 'incurved' chrysanthemums may be a difference of growth substance metabolism.

With single chrysanthemums (vars. 'Single Bronze' and 'Cleopatra') a similar inhibition of corolla unrolling has been obtained, whilst in the latter variety some 'outcurving' of apparently mature corollas was noticed.

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Nov. 7.

Force Constants and Molecular Structure

In previous papers¹ we have described measurements on the ultra-violet absorption spectrum of carbon suboxide, and have attempted to calculate the force constants of the linkages in this molecule from the measured normal vibration frequencies. A potential function was employed involving four constants, two of these representing 'cross-term interactions'. Unfortunately, at the time only the two symmetrical frequencies ($\nu_1 = 843$, $\nu_2 = 2,200$) were known accurately from the Raman data, and it was necessary to assume plausible values for the cross-term constants in order to obtain values for the main constants. Lord and Wright² have now published infra-red data from which the two unsymmetrical frequencies may be deduced ($\nu_3 = 2,290$, $\nu_4 = 1,570$). We thus have four frequencies and four undetermined constants. Insertion of the values gives $k_{CO} = 12.69 \times 10^5$, $k_{CC} = 15.0 \times 10^5$, $k_{24} = 5.10 \times 10^5$, $k_{12} = 2.43 \times 10^5$. k_{24} and k_{12} represent C—C—C and O—C—C interactions of the type previously suggested.

The new values of the main constants differ slightly from those previously found, but strengthen the hypothesis then suggested, that the bonds are intermediate between double and triple and that the molecule appears as a resonance hybrid. Moreover, the relatively high value of the interaction term k_{24} in such a molecule is in accordance with other related results, for which a reason was previously suggested. When applied to the relations of Badger and Clark connecting force constant and bond length³, the new values of the force constants give good agreement and much better than the old. We find for the C—C bond, with Badger's formula $r = 1.18$ A., with that of Clark $r = 1.165$ A., the electron diffraction value being 1.20 ± 0.02 A.; for the C—O bond $r = 1.21$ A. (Badger), 1.265 A. (Clark) and 1.29 ± 0.03 A. (observed).

We should like here also to refer to a recent note in NATURE by Bailey and Hale⁴ which seems to misinterpret calculations we have recently made of the force constants of linkages in ethylene and tetrachloroethylene⁵, and to raise objections which are invalid. Bailey and Hale point out the necessity of removing uncertainty as to what any particular force constant implies, and also the necessity of considering as far as possible molecules of the same symmetry type. They also refer to the difficulties involved in using a too artificial force field and point out that the calculations only refer to infinitesimally small amplitude. These matters, with others, are fully discussed by us in our detailed papers, and some of the arguments of Bailey and Hale are precisely those which are used by us. So far as the subsequent calculation for the case of ethylene and tetrachloroethylene is concerned, its merits and demerits are fully discussed by us in the paper referred to.

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Nov. 1.

¹ *Proc. Roy. Soc., A*, 157, 331 (1936); *J. Chem. Soc.*, 1291, 1384 (1937).

² *J. Chem. Phys.*, 5, 642 (1937).

³ *J. Chem. Soc.*, 1396 (1937).

⁴ NATURE, 139, 112 (1937).

⁵ *J. Chem. Soc.*, 1376, 1384, 1393 (1937).

Races with a High Proportion of Blood Group AB

In a "Research Item" in NATURE of October 2, the failure of Miss Macfarlane to confirm the high percentage of Group AB previously found in Tibetans is reported. May I quote another race with a high proportion of Group AB?

In an investigation of 1,000 Soussoux in French Guinea, J. S. de Goldflem¹ obtained the following results.

BLOOD GROUPS OF SOUSSOUX					
	No.	O	A	B	AB
Adults	500	1%	1%	9%	89%
Children	500	1%	1%	9%	89%

This race is of interest in that the percentage of AB exceeds 50 per cent which is the theoretical maximum in a stable race, for, where p , q and r are the frequencies of genes A, B and R respectively, then $p + q + r = 1$ and $2pq = AB =$ a maximum $= 0.50$, where $p = 0.50$ and $q = 0.50$.

A race having this group distribution could arise as the result of the mating between a race having more than 90 per cent A on one hand and a race having more than 90 per cent B on the other, but this group distribution would only appear in the first generation—and stability would be reached in the second. For example, in the race in question, the A and B children arising from the matings between AB and AB only would form nearly 40 per cent of the total children, using the formula:

$$A \text{ children from } AB \times AB \text{ matings} = 100 \frac{(AB)^2}{4}$$

per cent of total children.

A mutation occurring in this race at the present time could not, I think, give rise to this phenomenon.

It must be pointed out that Beth Vincent's technique was used for this observation.

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Nov. 11.

de Goldflem, J. S., C.R. Soc. Biol., 128, 391 (1936).

Anomalous Dielectric Constant of Artificial Ionosphere

APPROPOS our letter in NATURE of October 2, p. 586, it has been pointed out to us by Prof. E. V. Appleton and Dr. F. W. Chapman that though the curves delineating the variations of μ^2 with N and $1/f^2$ are quite correct, they cannot, however, be regarded as showing the relation between K and N , or $1/f^2$. In fact μ^2 can be identified with K only when $v = 0$. In the general case, for a conducting medium, $\mu^2 = K + \frac{c^2 k^2}{p^2}$. Thus, though μ^2 can take up values both greater and less than unity, as depicted in Figs. 1 and 2 of our letter, K cannot do so because $\mu^2 - \frac{c^2 k^2}{p^2}$ can only have values equal to or less than unity.

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Points from Foregoing Letters

A TABLE showing the amounts of radioactive phosphorus (relative to the total phosphorus) in the yolk of eggs, the liver and the blood of a hen, 28 hours after it had been administered by subcutaneous injection, is submitted by L. Hahn and Prof. G. Hevesy. From the present and previous experiments the authors infer that the liver of the hen (and not the blood corpuscles) is responsible for the formation of the phosphatides. These are then carried by the plasma to the ovaries.

A curve showing the usual form of the phase variation of the abnormal component of low-frequency radio waves near sunset is given by K. G. Budden and J. A. Ratcliffe; also an example of a type of disturbance of the curve which, the authors find, is connected with 'fade-outs' or with magnetic anomalies. They conclude that a 'catastrophic' ionospheric disturbance decreases the reflection height of the low-frequency waves.

By applying a magnetic field (16 gauss) to a low-pressure bulb containing 'gas' ionized by short radio waves (6 m.), E. W. B. Gill has been able to reduce considerably (to $\frac{1}{10}$ th) the ionizing potential needed for producing an electrodeless discharge. The author states that his experiments confirm Prof. V. A. Bailey's theory on what happens to wireless waves in the upper atmosphere.

J. W. Thompson, Wm. Corwin and J. H. Aste-Salazar find that, as compared with normal persons, the mentally unbalanced (schizophrenic) individuals show less physiological susceptibility to changed

external conditions. Generally speaking, they have regular respiration, small tidal air and cardiac output, low blood pressure, low basal metabolic rate, high arterial carbon dioxide and low oxygen saturation.

The activity of tetanus toxin is found by Drs. J. B. Bateman, H. Loewenthal and H. Rosenberg to be unaffected by a high-frequency field (radio waves of 3 m. length and potential gradient of 2,500 v./cm.) when conditions were such as to prevent heating.

Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou propose alterations in Kihhn's classification of animal reactions. The new terms make clearer the relations between the various reactions, they are not anthropomorphic like some of those discarded, and confusion between them no longer arises from their similarity of pronunciation.

Dr. S. G. Gibbons directs attention to observed differences in the development of the copepod *Eucalanus elongatus* in Californian as compared with Scottish waters. He asks if it is possible that the colder temperature of the water off the west of Scotland may prolong the incubation period so that the animal emerges from the egg in the second nauplius stage.

Using recent additional information on the infra-red spectrum of carbon suboxide, Dr. H. W. Thompson and J. W. Linnett have recalculated the force-constants of the linkage in the molecule of that compound. The new values, they state, strengthen the hypothesis that the bonds are intermediate between the double and the triple types.

Research Items

Sinanthropus VI

SOME important inferences are drawn by Prof. Franz Weidenreich (*Bull. Geol. Soc. China*, 16; 1936-37) from fragments of a skull of Peking man designated as *Sinanthropus* VI, which have been brought together in the laboratory from material collected in the Choukoutien cave from 1934 onward. These consist of a fragment of a right temporal bone, comprising the ear aperture and adjacent parts (belonging apparently to the same skull as the left temporal bone and adjacent parts found in 1934 and already described), three teeth, two molars and a premolar, as well as two fragments of a skull, of which one is the greater part of a left parietal, while in material from the same level as the three teeth were the right side of a frontal bone and the anterior part of the squama of a right temporal bone. It is considered certain that all these pieces belong to one and the same skull—an adult (old) female. From these fragments it has been possible to form a general idea of the contour of the frontal portion of the skull, which on comparison with *Sinanthropus* I and *Pithecanthropus*, shows much less curvature than Skull I in the sagittal planes and approaches very closely to the frontal bone of *Pithecanthropus*. In a frontal direction between the inferior temporal lines of both sides, it is less curved than Skull I and indeed is even flatter than *Pithecanthropus*. On a profile view, Skull VI coincides practically in all its lines with those of *Pithecanthropus*. A further discovery is a very small fragment, in certain respects, however, of very great importance. This is the right moiety of the posterior arch of an atlas. There cannot be any doubt that this is a human first cervical vertebra, and that it belongs to *Sinanthropus*. It does not display any distinct fundamental difference when compared with that of recent man. Its interest lies in the fact that it adds support to the view put forward on the evidence of the absence of long bones from the cave, that the skulls were brought into the cave by man and were there broken at the base or split open in order to get at the brains.

Bull Culls of Ancient Egypt

A DISCOVERY which should be of considerable interest for the study of the bull cult in ancient Egypt, when fuller details are available, is reported from Cairo. Dr. Drioton, director-general of antiquities, it is reported by the correspondent of *The Times* in the issue of December 13, has announced the discovery near Zagazig of twelve large granite sarcophagi, which had formerly contained the mummies of sacred bulls, dating from the fourth century B.C. Although these tombs had suffered, presumably from the activities of grave robbers, the internal decoration of three of the sarcophagi is said to have been sufficiently well preserved for it to be possible to make out that they dealt with the future destinies of the sacred bulls, an aspect of the bull cult which thus becomes known for the first time. According to Dr. Drioton's report, it would appear that the sacred bulls were introduced by their patron divinities into the assembly of all the gods. Further, that the outstanding feature of the posthumous destinies of the sacred bulls was their reunion with

the moon. This is new to Egyptology. Near the sarcophagi of the sacred bulls were found small chambers, in which were mummies of sacred falcons, with their eggs buried beside them in jars. Further excavations are to be carried out on the site.

Temperature and the Growth of *Drosophila* and of *Lymnaea*

THE influence of temperature on the dimensional characteristics of *Drosophila melanogaster* has been investigated by several biologists. These studies concern only the final growth stage, while growth and development of this insect in the larva and pupa form the subject of a recent paper by Mr. Takeo Imai (*Sci. Rep. Tohoku Imp. Univ.*, 4th Series (Biology), 11, 403-417; 1937). It is shown that temperature influences the larval length, length of mouth armature and pupal length, in that high temperature causes a diminution of their dimensions. Two diverse hypotheses are held in regard to the explanation of thermal effect on size. In one case, it is considered to be dependent on the nutritional condition; diminution of size at high temperature is the result of a deficiency of food. In the other, it is maintained that the thermal effects result in modification of the chemical equilibrium. This latter view is held by the author, who suggests that high temperature produces effects that are connected with modification of the metabolic balance of the growing system; or, in other words, the balance between anabolism and katabolism is suggested as the cause of the morphological differences described. In a second paper in the same journal (pp. 418-432) the author formulates the same explanation with regard to the effects of temperature on larval shell size in the mollusc *Lymnaea*. It appears that growth of the larval shell occurs in two cycles, but while higher temperatures cause acceleration of development, the final shell size is diminished at both growth-cycles.

Associated Growth of Herbage Plants

A SERIES of three very interesting papers upon the physiology of pasture grasses when grown in association with legumes has been received from Australia (*Bull. Council for Sci. Ind. Research*, No. 105. Pp. 40+10 plates. Melbourne, 1937). A first paper by Messrs. H. C. Trumble and T. H. Strong indicates that no evidence has been obtained for the view that grasses are able to derive nitrogen from associated legumes during the vegetative stages of the latter, though the subsequent decay of nodules releases nitrogen to the soil. The other papers are written by Messrs. H. C. Trumble and R. E. Shapter, and discuss the physiology of specific associations of grasses and legumes. Yield of Wimmera rye-grass is increased by manuring with both phosphorus and nitrogen, whilst the yield of subterranean clover is raised by phosphorus only. The mixture gives increased yield with phosphorus at all levels of nitrogen. Many other results are given in detail, and the practical conclusion is that the greatest increase in production from the podsolized soils of southern Australia is to be obtained from liberal dressings of soluble phosphate to an associated crop of grass and suitably inoculated legume. The third paper shows that a perennial grass, namely, *Phalaris tuberosa*, may obtain considerable

nitrogen from an associated annual legume such as *Medicago denticulata*, which grows rapidly, and presumably begins to decay at an early stage. The grass obtains approximately 30 per cent of the nitrogen present in the root system of the legume in this particular combination.

Genetics of Rice

THE genetics of rice is receiving considerable attention in India. Mr. B. S. Kadam crossed a wild Bombay rice, which sheds its grains completely, with a non-shedding Burmese variety (*Proc. Indian Acad. Sci.*, 14, No. 3). He found the shedding character completely dominant and caused by two duplicate genes. Ramiah and Rao, in a similar cross in south India, found the F_1 intermediate, and evidence of more than one gene. Mr. Kadam also found (*J. Indian Bot. Sci.*, 14, No. 2) that in a Burmese variety which develops anthocyanin in its roots when exposed to sunlight, the condition was determined by two complementary genes, A , without which no colour can appear in the plant, and R , a specific gene for root colour. By crossing two Indian varieties (*J. Heredity*, 27, No. 10) he found that one possessed a gene which produces red pigment throughout the plant, while the other contained an inhibitor which prevented anthocyanin developing in the leaf blades. Messrs. Kadam, Patil and Patankar (*Indian J. Agric. Sci.*, 7, No. 1) found from various crosses of rice varieties no hybrid vigour in respect of height, tillering, panicle-length or weight of the plant, but an increased yield in some crosses.

Atomic Weight of Carbon

THE atomic weight of carbon has been changed in the current report of the Committee of Atomic Weights of the International Union of Chemistry from 12.00 to 12.01, largely on the basis of gas density and mass-spectrograph measurements, which were confirmed by Baxter and Hale (1936-37), who obtained the value 12.010 from the combustion of hydrocarbons. A. F. Scott and F. H. Hurley (*J. Amer. Chem. Soc.*, 59, 1905; 1937) have now determined the ratio of benzoyl chloride to silver, the chloride being hydrolysed and precipitated as silver chloride. With the current international values for hydrogen, chlorine and silver, the value $C = 12.0102$ was found. With the value $H = 1.0081$, the value becomes $C = 12.0100$, and the same figure is obtained if 107.879 is used for silver. The same authors (*ibid.*, 2078) have used the value $C = 12.010$ to recalculate the atomic weight of sodium from the ratios involving sodium carbonate. With the current international values for silver, bromine and iodine, three values of 22.993, 22.993 and 22.994 are obtained, about 0.003 lower than the international value for sodium of 22.997, but in agreement with the value 22.994 found by Johnson in 1933 from the ratio $NaCl : Ag$. No mass-spectrograph value is available.

Magnetostriction

WHEN magnetic material is placed in a magnetic field, small changes in its physical dimensions take place. This phenomenon is known as magnetostriction, and although studied by Kelvin and Bidwell about seventy years ago, it is only recently that it has attained both theoretical and practical importance. It is applied usefully in practice in connexion with the magnetostriction oscillator and the magneto-

striction echo-depth recorder. There are other physical phenomena connected with it, such as the changes it brings about in the magnetic properties of the material, known as the Villari effect. In soft iron, for example, the permeability is increased in weak fields but in strong fields it is weakened. This is usually referred to as the 'Villari reversal'. In the *Beama Journal* of October, W. Alexander and J. Swaffield describe some of the practical applications of magnetostriction. An important application due to Pierce is to use it for starting and controlling electrical oscillations. A special valve oscillator works on this principle. The magnetostriction echo-depth recorder is used for taking soundings at sea and has now reached the commercial stage. The principle is to transmit through the hull of the vessel a high-frequency sound impulse generated in a special type of magnetostriction oscillator. This is reflected from the sea-bed and recorded by apparatus similar to the transmitter but acting in the inverse way, the sound impulse being converted into an electrical one. After amplification and rectification, the voltage produced is applied to a chemical recorder and produces a mark on paper. The time which elapses between the transmission of the impulse and the marking of the paper is a measure of the depth at any instant. Thus the chain of dots forms a continuous trace giving the configuration of the sea-bed. In the United States a magnetostriction oscillator has been developed which produces intense audible vibrations of frequencies of 8000 cycles per second, capable of fracturing glass and of producing useful bactericidal effects.

An Annual Change in Longitudes

IN *Mon. Not. Roy. Astro. Soc.*, 97, 9, October 1937, Dr. Frank Schlesinger has a paper with the above title, in which he disputes the conclusions of Loomis and Stetson that longitude changes between Washington and Greenwich as well as Paris are correlated with the hour-angle of the moon. Kawasaki showed quite recently that these changes in longitude could be equally well represented by an annual term which is completely independent of the position of the moon, and Schlesinger now treats the whole material as a unit. His results show that the evidence is in favour of the annual hypothesis as against the lunar, and he seeks for some causes for the annual change in longitude. Consideration is given to the wanderings of the earth's pole of rotation with respect to a fixed axis in the earth, and this would give rise to variations in latitude, longitude and also in azimuth. The latitude variations have been well observed at the Cape Observatory, Washington and at other places, and a simple expression is given which connects longitude and latitude changes. Using this for Washington, differences of longitude are computed between this station and Greenwich as well as Paris. On comparing these with the observed differences, the agreement is as close as might be expected between Washington and Paris, but is not so good between Washington and Greenwich. It is suggested that the polar motion is at least a partial explanation, and may be a complete explanation of the longitude changes which have been found to exist between Paris and Washington. Large differences between Paris and Greenwich still exist, and if these could be cleared up the polar motion could practically be accepted as an explanation of the Greenwich-Washington changes in longitude also.

British Institute of Radiology

ANNUAL CONGRESS AND EXHIBITION

THE eleventh Annual Congress and Exhibition of the British Institute of Radiology was held, as usual, at the Central Hall, Westminster. The Congress was opened on December 8 by the president, Dr. R. J. Reynolds, in the presence of Her Majesty Queen Mary, who, before the opening ceremony, made a tour of the Exhibition and took a great interest in the various items shown.

The papers read at the Congress dealt with X-rays in industry, the medical ones treating the use of X-rays in industrial diseases, and the physical papers dealing with X-rays in industrial research. The latter symposium, held on December 9, was opened by Dr. G. Shearer, who pointed out that technical advances in materials followed largely on advances in the detail with which the materials could be studied. Great progress had followed improvements in the microscope, while the development of the 'X-ray microscope', which revealed the inner structure of materials, had resulted in further striking developments. Among the main properties of solids revealed by X-ray methods were their compositions, grain sizes, the orientations of the constituent crystals and their states of perfection. As examples, he quoted the importance of grain size in paints and electrolytic deposits, and stated that imperfectly formed crystals were desirable in steels intended for permanent magnets and perfectly formed crystals for transformer steels.

Dr. H. J. Gough and Mr. W. Wood read a paper on the use of X-ray methods in the investigation of failure in service, which dealt with one phase of the problem of fatigue. Stressing the importance in design of an accurate knowledge of the strengths of materials, the authors pointed out that apparent strengths depended markedly on whether the stresses were continuous or cyclic. From a knowledge of atomic constitution it was possible to deduce values for the strengths of materials, but these were usually found to be far greater than those obtained in practice. It had been thought that the discrepancy was possibly due to flaws, but in that case it was difficult to understand how relatively consistent values of the strengths could be found. Even before X-ray studies were undertaken, it had been found that the failure might be due to some change in the micro-structure of materials, particularly of metals. X-ray studies of stressed metals had shown that the sizes of the crystal grains remained constant over the region in which Hooke's law was obeyed, but at the yield-point there was a break-down in the crystal grains, which continued until a more or less homogeneous 'crystallite' structure was obtained. This breaking-down of grains seemed to give a power of accommodation to the material, and fracture only occurred when all the grains had broken down and the accommodatory power ceased. With cyclic stresses similar phenomena were observed, with the important difference, at present not understood, that deterioration of the material in this case is local, whereas with continuous stresses it is general. The authors stated that many problems remained unsolved, one of the most important being the reason for the

crystallite structure, which implies a kind of 'crystal molecule'.

Dr. W. T. Astbury discussed X-rays and wool fibre, pointing out that wool, in common with other organic materials such as hair, horn, muscle, etc., consists of bundles of long polypeptide chains somewhat like a 'sliver' of wool on a minute scale. Wool, he said, is characterized by great elasticity and in favourable circumstances can be stretched to twice its natural length, and will recover when the stress is removed. Study of the material by X-rays and by other methods showed that wool has a kind of 'step-ladder' structure consisting of long chains of molecules, cross-linked by side chains. The chains were normally folded, but in the presence of water the chains could be straightened and would recover. This accounted for the power of recovery of shape by woollen garments after stretching when wet. At higher temperatures (steam) the side-chains were hydrolysed, and the material largely lost its power of recovery. This fact was made use of in various industrial processes including the 'permanent' waving of hair. X-ray studies had revealed clearly two definite states, normal and hydrolysed, and had shown the underlying nature of the change.

Dr. A. J. Bradley and Mr. H. Lipson read a paper on a "Rapid Survey of Ternary Alloy Systems by X-rays", pointing out that at present it is not known why the various alloys of three metals, for example, copper, nickel and iron, have such varied properties. The crystalline form of the alloys is usually cubic and most commonly consists of face- or body-centred cubes, and often a mixture of both. Although microscopic examination will show the main features of the systems, careful X-ray examinations are necessary to find the complete diagram, as in many cases the various zones are very narrow. The authors stressed the particular necessity of studying the alloys in great detail so that the finer points should not be missed.

The twentieth Silvanus Thompson Memorial lecture was given by Prof. J. A. Crowther, his subject being "The Biological Action of X-rays: a Theoretical Review". Pointing out that, on account of simplicity of experiment, most recent research had been carried out with single-celled materials, Prof. Crowther said that the cells showed marked variations in radio-sensitivity during their life-history, young cells being more sensitive than older ones and cells about to divide being particularly sensitive. Lethal doses of X-rays ranged from 40 röntgens for the most sensitive states to 35,000 röntgens in the insensitive states. Intermediate doses, insufficient to cause the death of the cell, may prevent normal cell-division and may produce mutations. It appears that the sensitive unit is not the complete cell or its nucleus, but some smaller structure, possibly sub-microscopic in size. This might account for the insensitivity of normal cells, which are virtually homogeneous structures.

Considerations of the energetics show that such effects can only reasonably be expected on the basis of a localized quantum action. Two theories of the mechanism of radiation-action had been put forward,

one based on the possibility of a poison being formed, and one suggesting a direct or 'bullet' action, which may be due to the direct action of the quantum of radiation energy, to the production of an ion-pair or to the passage of an electron track through the sensitive part of a cell. Consideration of wave-length effects should ultimately show which is the true explanation.

Dealing with the two theories as to the mechanism, Prof. Crowther pointed out several objections to the poison theory: the objection that the amount of poison was small (100 r. producing a concentration of the order of 1 poison molecule in 10^8 normal molecules) was not considered valid, but other evidence concerning temperature effects, variations of effects with dosage rates and times seemed to point against the theory. Further, the known survival and mortality curves could only be considered consistent with the poison theory on the basis of certain unlikely

assumptions. On the other hand, the 'bullet theory' rationally explained most of the observed facts, including the insensitiveness of the reactions to temperature variations. In due course it might be hoped that the mechanism would be understood, and at present Prof. Crowther thought that possibly the root cause of radio-biological action might be found in the variations of the electric charges on colloidal particles when irradiated.

The Research Section of the Exhibition contained exhibits from fourteen individuals and institutions, illustrating research in technical, biological and physical problems, and included examples of early apparatus and radiographs. In the Industrial Exhibition was shown a commercial X-ray tube for operation at 1,000 kilovolts. In this tube the electrons are excited in three stages, each of 400 kilovolts, and the tube may be operated either with one pole earthed or in the balanced arrangement.

Nicotinic Acid and the Pellagra-Preventing Vitamin

IN an address to the Birmingham University Biochemical Society, on December 9, Dr. Leslie Harris, of the Cambridge Nutritional Laboratory, referred to the findings in some current work on the chemical nature of the pellagra-preventing factor.

Dr. Harris said that the suggestion of a connexion between nicotinic acid and 'vitamin B' is not a new one. About twenty-four years ago, Funk in England and Suzuki in Japan succeeded in isolating nicotinic acid from active 'anti-neuritic' concentrates, and it was once supposed that nicotinic acid might in some way be related to vitamin B₁. But later investigations proved conclusively that pure nicotinic acid itself had no anti-neuritic action, and there the matter was left for some years, although the possible physiological importance of nicotinic acid was emphasized by the discovery of Euler that the acid amide of nicotinic acid is a component of cozymase. Recently, however, it has been found that nicotinic acid or its amide has a growth-promoting action for certain micro-organisms (Knight, Mueller, Holiday), and for pigeons or rats kept on various diets deficient in some portion of the B₁ complex (Funk and Funk; Frost and Elvehjem). Special importance attached to the statement of Elvehjem and his co-workers that nicotinic acid or its amide was curative of 'blacktongue' in dogs; and work has now been done to link these new results with observations made at the Cambridge Nutritional Laboratory a year or so back. Here experiments by Birch, György and Harris showed that what had hitherto been called 'vitamin B₁' consisted in reality of three distinct factors, namely, lactoflavin, vitamin B₆ (the 'rat dermatitis factor') and the pellagra-preventing (P.P.) factor proper. The latter appeared to be identical with the 'anti-blacktongue' factor for dogs. More recently, Harris confirmed these results as to the tripartite nature of the 'vitamin B₁' complex and showed furthermore that monkeys also developed a disease ('monkey pellagra') analogous with human pellagra when restricted to a diet deficient in the P.P. factor but containing the other known constituents of the B₁ complex.

A trial of nicotinic acid on monkeys which were developing symptoms of nutritive failure on a diet deficient in the P.P. factor has now indicated that this substance has in fact a curative action: further work is needed, however, to ascertain whether nicotinic acid is the sole deficiency in such a diet. Nevertheless, these results and the findings of other workers seemed sufficiently encouraging to warrant a trial on human beings suffering from pellagra.

Through the collaboration of Dr. A. Hassan of the Faculty of Medicine, Cairo, tests under controlled conditions have been made on pellagrins in Egypt. In preliminary trials, two cases of spontaneously occurring pellagra at the Khanka Asylum and three at Abuzaabal Prison were examined, together with three controls. All variables, such as the composition of the basal diet, the amount of work done daily, and the extent of exposure to sunlight were kept unaltered for all subjects. Nicotinic acid given by mouth up to a maximum level of $\frac{1}{2}$ gm. daily was found to hasten the subsidence of the erythema in all the cases. At the asylum, the general condition of the pellagrins was likewise improved, but at the prison the beneficial effect seemed largely limited to the specific action on the erythematous lesions. It may safely be concluded therefore that the nicotinic acid duly rectified a deficiency in these pellagra-producing diets. The results make it seem likely that the prison diets were deficient in some additional factor, and in fact the asylum diet did contain more meat, more greens, was better prepared and included some wheaten bread—the bread at the prison consisting of one quarter of maize. The possibility has therefore still to be borne in mind that nicotinic acid is not the sole major deficiency in some pellagra-producing diets—in other words, that pellagra as sometimes seen may be accompanied by more than one dietary error. Apart from this, it seems probable that nicotinic acid (or amide) is the less active form, or 'precursor' of a more active variation of the P.P. vitamin, which can be formed from it within the animal body.

Cellulose, Starch and Glycogen

A VALUABLE article on recent work on cellulose, starch and glycogen, by Prof. H. Staudinger, has appeared in a recent issue of *Die Naturwissenschaften* (25, 673; 1937). The fact that cellulose, starch and glycogen can be converted into esters without altering the degree of polymerization, and can be reconverted into the original substances, as shown by molecular weight determinations, optical rotation and other properties, shows that the glucose residues in the colloidal particles of these substances are linked by principal valencies. The colloidal particles are therefore macro-molecules. The determination of the molecular weights of these substances is discussed. The ebullioscopic and cryoscopic methods are difficult to apply owing to the smallness of the effect, and other anomalies; but molecular weights can be satisfactorily determined from osmotic pressure data using the equation of Schulz, or by Svedberg's method using the ultra-centrifuge. It is also possible to determine them from viscosity data by an equation due to Staudinger. All these methods agree in giving a value about 200,000 for the molecular weight.

X-ray analysis shows the molecule of solid cellulose to be extended, and there is reason for believing that this is also the case in solution. Viscosity determinations show, however, that in starch there is a bending back of the molecules. Starch molecules are only about one eighth as long as they should be if extended. With glycogen,

solutions of the same concentration have the same viscosity, no matter what the degree of polymerization. This points to the existence of spherical macro-molecules in this case. The linking of the glucose residues in these three compounds is discussed, and the connexion between physical properties and the shape of the molecule is emphasized.

Colloidal particles can be classified into two groups, linear and spherical colloids, according to the shape of the particles. The latter are powders in the solid state, and dissolve in water without swelling to give solutions of low viscosity. Linear colloids, on the other hand, are tough, fibrous substances, which dissolve with considerable swelling, and form viscous solutions. Glycogen is a typical spherical colloid, and its physical properties are not greatly altered by change in the size of the molecule. Cellulose is a typical linear colloid, and the physical properties depend a good deal on the size of the molecule. Starch occupies a position intermediate between cellulose and glycogen. A similar difference in structure of the macro-molecules is found in the case of the albumens.

The form of the macro-molecule of polysaccharides and albumens decides the different functions of these substances in the living organism. Cellulose forms the solid portions, whereas substances which have to be transported through the organism are spherical colloids.

Twenty-one Years of Glass Technology

THE subject of the presidential address delivered to the Society of Glass Technology at its twenty-first anniversary meeting at Sheffield by Prof. W. E. S. Turner was "Twenty-one Years. A Professor Looks Out on the Glass Industry". This address has now been published (Society of Glass Technology, Sheffield. Pp. 70+46 tables. 10s.; postage 3d.). Whilst its introductory and short concluding chapters are concerned mainly with the growth and development of the Society of Glass Technology and its international relationships, the major portion is occupied with an account of the great advances, mechanical, chemical and physical, which have revolutionized the ancient craft of glass-making throughout the world. The volume is one for the student of social history and of commerce as well as for those interested in the advances of applied science.

That the development of the completely automatic machine has been the dominant factor in influencing conditions in the industry during the period under review is brought out clearly by means of a carefully collected mass of evidence. The tendency to mechanization was already evident before 1916, as, for example, in the Owens' bottle machine which was brought to a commercial stage in the early years of the century, and by 1914 was in operation in ten European countries as well as in the United States. But its use was limited to a small number of licensees, and similar conditions

prevailed with the few machines available in other sections of the industry.

During the intervening years, mechanical progress has been very rapid, and there are now in wide use seven or eight different types of bottle machine, as well as automatic machines for the manufacture of tumblers and other domestic ware, plate and sheet glass, electric lamp bulbs and tubing. The change has led to an enormous increase of productive power, as is evidenced, for example, by a growth of the annual output of containers in Great Britain between the years 1924 and 1935 by sixty-two per cent, or to take a still more striking example, of an increase of machine-made electric lamp-bulbs in Europe from 2½ millions in 1919 to 127 millions in 1932.

Concurrently with the advance of the machine has been the steady disappearance of the skilled glass-blower, for a single bottle machine may equal the output of more than fifty men, and, to take an extreme case, the most modern lamp-bulb machine, the Corning 399, has produced more than 500,000 bulbs daily, equivalent to the production of 500 glass-blowers. The same tendency has not been at work in other branches of labour, for there is evidence even of a slight improvement in total employment in the industry, due to the great increase of sales of glassware, largely induced by the cheapening of production, for which the machine has been primarily responsible.

Two other consequences have issued from the increased use of machinery. The first is the ousting of the small works and the concentration of production to an increasing degree in fewer but larger factories (the number of window glass works, for example, in the United States fell from 79 in 1919 to 18 in 1933). A second result has been a rapid world-wide spread of the industry, for the recent growth in many additional countries, of which Japan is an outstanding example, would not have been possible if it had depended on a supply of skilled glass-blowers.

With the development of machine production, and indeed rendered necessary by it, there has been a corresponding improvement in furnaces and refractory materials, in feeding devices for molten glass, and in lehrs for annealing the finished product.

In the striking advance here so admirably illustrated, the chemist and physicist, in addition to the engineer, have played a decisive part. To them has fallen such tasks as providing purer and more varied supplies of raw materials in ever-increasing quantities, and exploring the relationships between the chemical composition and chemical and physical properties of glasses so that a material most suitable for each type of production might be obtained. But the attention of the technologist has been by no means confined to the field of mass production, and a number of fresh developments in various fields during recent years testify to his industry. Among them may be cited 'Vita' glass, Safety glasses, Pyrex glass, Vitrolite, glass building bricks and modern glass wool or silk.

These and other advances in the art and science of glass-making have been reflected in the marked growth of technical training and research institutions and in the copious output of valuable literature, of which the *Journal of the Society of Glass Technology* is a striking example.

Science News a Century Ago

Debate on Civil List Pensions

IN the House of Commons on December 19, 1837, Mr. Rice, the Chancellor of the Exchequer, moved that the Civil List Bill be read a third time. To this, Mr. Grote, the historian, then M.P. for the City of London, replied by moving an amendment that the clause empowering Her Majesty to grant a certain sum [£1,200] annually should be struck out. He maintained that pensions ought no longer to be assigned at the mere arbitrary and irresponsible will of the Sovereign. The proper distribution of these involved a great public duty, and the House should take them under its control.

Sir Robert Peel, speaking against the amendment, said that the sum of £1,200 as a provision for the United Kingdom was too limited. The honorable gentleman [Mr. Grote] would do away with pensions altogether, but cases would arise—cases where it would be proved that men of science had devoted the energies of their minds and fortunes for the benefit of society, and then the country would revolt against the niggardly conduct of Parliament. A pension and an honorary dignity were on the same principle awarded by the Crown. Literary and scientific men should, in his opinion, receive pensions if they stood in need of them; if not, they should receive those conventional distinctions, which the Crown alone should have the power of conferring. Mr. Buller, the member for Liskeard, who agreed in

the main with Sir Robert Peel, said it was almost impossible to point out one instance of a person who had benefited his posterity either by his writings or his advancement of science, from the time of Chaucer to the present day, who had not been supported by either the bounty of the Crown or the charity of some individual.

In the course of the debate, references were made to Locke, Johnson, Southey, Wordsworth, Coleridge, Dalton, Wollaston, Airy and Mrs. Somerville. Mr. Buller also referred to the case of "Mr. Wallace, who had been for many years Professor of mathematics at Edinburgh, and who was second only to Ivory in his talents or attainments, and yet when he applied for a pension he was refused: he considered this a cruel case." Mr. Grote's amendment was lost by 23 votes to 125.

Faraday's Experimental Researches

At a meeting of the Royal Society on December 21, 1837, Faraday continued the reading of his "Experimental Researches in Electricity", Eleventh Series. The reading of the paper had been begun on December 14 and its concluding portion was read on January 11, 1838. The official abstract said: "The object of this paper is to establish two general principles relating to the theory of electricity, which appear to be of great importance: first, that induction is in all cases the result of the actions of contiguous particles; and secondly, that different insulators have different inductive capacities. . . . In conclusion, the author remarks, that induction appears to be essentially an action of contiguous particles, through the intermediation of which the electric force originating or appearing at a certain place, is propagated to or sustained at a distance, appearing there as a force of the same kind and exactly equal in amount, but opposite in its direction and tendencies. Induction requires no sensible thickness in the conductors which may be used to limit its extent. . . . But with regard to dielectric or insulating media, the results are very different; for their thickness has an immediate and important influence in the degree of induction. As to their quality, though all gases and vapours are alike, whatever be their state, amongst solid bodies, and between them and gases, there are differences which prove the existence of specific inductive capacity."

Naturalists in Abyssinia

"FRENCH and German naturalists," said the *Athenæum* of December 23, 1837, "are overrunning Abyssinia in all directions. Letters have just been received from Schimper, who was sent by the Würtemberg Naturalists' Society, to Africa. After sending home a collection of plants from the Hedjas and Mount Sinai, he arrived at Massawa in January, where great obstacles were raised to his prosecuting his journey, by the recent circumstance of two French travellers having been killed in Abyssinia. However, he succeeded in reaching Arkiko and Haley, and thence sent on to the Abyssinian King Wabeah, who was encamped at Hazabo, between Adowa and Axum, for permission and safe conduct. This was granted, and he was soon welcomed at Adowa, the king's capital, by the German missionaries, sent from England; Blumhardt and Isenberg. From thence he intends to prosecute his scientific tour to the Abyssinian Alps." Wilhelm Schimper was born in Mannheim in 1804 and died at Adowa in 1878.

Societies and Academies

London

Royal Society, December 9.

R. W. GURNEY and N. F. MOTT: Theory of the photolysis of silver bromide and the photographic latent image. An attempt is made to explain the photolysis of silver halides in terms of the concepts of atomic physics. The mechanism by which the silver atoms formed by the light coagulate to form specks of metallic silver is discussed. The ideas used in this discussion are then turned to the photographic latent image, and are shown to account qualitatively for the variation of developed density with temperature, and, for given exposure, with intensity of light. A brief discussion is given of the Herschel effect, and of sensitization by dyes.

A. L. REIMANN: The temperature variation of the work functions of clean and of thoriated tungsten. Measurements were made of the contact potential difference between a constant source of electrons and a neighbouring tungsten filament collecting space-charge-limited electron current, the condition of which was varied. This filament was either clean or covered with a layer of thorium atoms, and, in addition, it was held at various temperatures. In this way direct information was obtained concerning the rates at which the work functions of clean and fully activated thoriated tungsten (W-Th) vary with temperature. Within the limits of experimental uncertainty there is no difference between the temperature coefficients of the two work functions. The temperature coefficient found is about that which would be required to account for the observed value of the thermionic constant A of clean tungsten on the assumption of practically perfect transmission. It must be concluded that the factor (of the order of 10-20) by which the A of W-Th is less than that of clean tungsten is due to internal reflection of electrons at the W-Th surface.

Paris

Academy of Sciences, November 3 (*C.R.*, 205, 761-824).

GEORGES CLAUDE: The search for aeroplanes lost at sea. Remarks on the use of fluorescein.

ROBERT ESNAULT-PELTERIE: The coefficient of self-inductance of a solenoid. Two approximate formulæ are suggested, one giving an accuracy of 3 per cent and the other of 0.1 per cent.

GEORGES GRAUD: A new category of equations where the principal values of integrals are represented.

JEAN CABANNES and CHARLES BOUHET: An attempt at the classification of the Raman lines of a quartz crystal.

MARC KRASNER: The definition of certain non-commutative rings. The classification of the primitive extensions of bodies with discrete valuation.

E. J. GUMBEL: The generalization of Boole's inequality.

HENRI CARTAN: Filters and ultra-filters.

ERNEST VESSIOT: The equations $F(x, y, z, p, q, r, s, t) = 0$ which have a general explicit integral.

MICHEL GHERMANESCU: A new class of nuclei of Fredholm.

JEAN LERAY: The solution of the problem of Dirichlet.

JEAN DUFAY and SSU PIN LIAU: The colour indices of the O and B stars and the selective absorption of light in space.

GEORGES REBOUL and JEAN REBOUL: The ionizing radiations of low quantum emitted spontaneously by the ordinary metals. Ordinary metals, like the true radioactive metals, constantly emit radiations. These appear to belong to the bands situated in the region of the soft X-rays.

VITOMIR H. PAVLOVIĆ: An improved apparatus for the subjective study of colour mixing.

RENÉ BERNARD: Stimulation potentials of the B^H and C^H levels of the nitrogen molecule.

TIEN KIU: Remarks on photographic plates sensitized with salicylate.

ALEXANDRE TRAVERS and ROBERT DIEBOLD: The isolation of pure cementite by acid attack of ferrous materials and on some physical properties of this body. The product isolated contained 6.6 per cent of carbon, the theoretical figure being 6.67 per cent. The Curie point, electrolytic potential and X-ray spectrum were determined.

PAUL COUTURIER: The action of mixed organo-magnesium derivatives on some hydroxy or alkoxy aromatic amides.

PIERRE MASTAGLI: The reducing action of the alkaline benzylates on hydratropic and α -alkylcinnamic aldehydes.

GEORGES DUPONT and CHARLES PAQUOT: Some reactions of isoprene and of dimethylbutadiene.

GEORGES BRUHAT and ANDRÉ BLANC-LAPIERRE: The double refraction of quartz by compression and its dispersion in the ultra-violet.

GEORGES DÉJARDIN, ALBERT ARNULF and DÉMETRE CAVASSILAS: The absorption coefficients and average temperature of atmospheric ozone.

DAVID MALAN: Stormy discharges in the upper atmosphere.

RENÉ SOUÈGES: The embryogeny of the *Convolvulaceae*. The development of the embryo in *Convolvulus arvensis*.

MARCEL GOMPEL: Researches on the oxygen consumption of some coastal aquatic animals.

PAUL WINTREBERT: Morphogenesis and epigenetic induction.

AUGUSTE and RENÉ SARTORY and JACQUES MEYER: The infection of cultures with a fungus by *Rhizoglyphus echinopus*, a parasite of the potato.

GEORGES MOURQUAND and HENRY TÊTE: Chronic food deficiency (partial C avitaminosis). Reversible and irreversible processes.

Moscow

Academy of Sciences (*C.R.*, 16, No. 4, 1937).

N. M. ERMOLAJEV: The expansion of an infinite integral into a semi-convergent series.

G. A. TIKHOV: The deviation of light rays in the gravitation field of stars.

A. A. ULJANOV: Radiations accompanying the corrosion of metals (1).

V. I. NIKOLAJEV and A. K. SENJUTA: Dehydration of mirabilite *in vacuo*.

A. IMŠENECKI: The morphology of large bacterial cells.

P. A. POVOLOČKO: (1) Chromosome morphology in *Punica granatum* L. (2) Causes of sterility in winter-grown plants of *Nicotiana tabacum*.

M. CH. ČAJLACHEJAN: Concerning the hormonal nature of the plant development process.

B. A. ZENKOVIĆ : Food of the Far Eastern whale.

A. A. VOITKEVIČ : Morphogenetic activity of different parts of the hypophysis (6). Experiments with the implantation of the posterior part of the hypophysis to tadpoles.

V. V. POPOV and V. S. POPOV : Is the cornea of metamorphosed anurans determined ?

V. V. POPOV, S. P. EVDOKIMOVA and A. G. KRAYMOVA : The lens-forming activity of the epidermis in larval and adult Amphibia.

V. V. POPOV, M. N. KISLOV, M. F. NIKITENKO and P. S. ČANTURIŠVILI : The lens-forming activity of epithelium in embryos of *Pelobates fuscus*, *Bufo viridis*, *Bombina bombina* and *Triton cristatus*.

Vienna

Academy of Sciences, October 14.

W. OBERHUMMER : Possibility of dissolving chromic oxide and chrome iron ore at room temperature. Silver nitrate catalyses the solution of chrome iron ore by dilute sulphuric acid.

GERTRUD WILD : Spectroscopic analysis of fluorites. The presence of rare earths in natural fluorites is confirmed.

E. EPSTEIN : Electrical precipitation of the disperse phase of organic and inorganic dispersoids by radium emanation. α -Particles cause a reduction of the charge and an increase in the size of the particles in phosphatide and gold sols, leading in the former case to flocculation and in the latter case to colour changes.

K. SCHWARZ and F. EBSTER : Apparatus for the production of electrons of very high energy.

F. SCHOSSBERGER : (1) Use of the fine structure of X-ray absorption edges for the determination of crystal structure. (2) Precision X-ray camera for obtaining powder diagrams at high temperatures, and an apparatus for measuring X-ray diagrams.

C. NEUBERG and C. H. SCHWETZER : Agar-agar.

D. BALAREW : Application of the phase rule to crystal systems.

H. MACHE and O. MOSZKOWICZ : Ionization of air at low pressures by γ -rays: parabolic law for the ionization current. It is shown that if, for pressures greater than 100 mm., current-potential curves be plotted for various amounts of ionization, then points corresponding to the same degree of saturation all lie on a parabola.

H. PRZIDRAM, LEONORE BRECHER and MARTHA GEIRINGER : Colamin, the physiologically active component of choline.

F. MAUSER : Synchronous metamorphosis of the legs of *Dixippus morosus* Br. et Redt.

GERTA SCHMID : Conditions for the development of the imaginal red coloration on the fore legs of *Dixippus morosus* Br. et Redt.

O. HRABÍK : Local transformation of solid and hollow bones of *Molge cristata* Laur. It is possible to interchange a hollow bone from one limb with a solid bone from another. In certain cases these bones become transformed so as to become appropriate to their new position.

A. W. REITZ and R. SABATHY : Studies of the Raman effect (78). Nitrogenous substances (8). Nitriles.

A. WARSBERG : Influence of morphine on the excretion of salt in the urine.

K. FEDERHOFER : Normal vibrations of spherical shells (2).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :

JUNIOR SCIENTIFIC OFFICERS (chemist and engineer) at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (December 30).

SENIOR LECTURER IN HIGHWAY ENGINEERING in the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (January 7).

LECTURERS IN CIVIL, ELECTRICAL AND MECHANICAL ENGINEERING in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (January 19).

PROFESSOR OF MINERALOGY AND GEOLOGY in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (January 31).

ASSISTANT for research on various diseases of small fruits at the East Malling Research Station, East Malling, Kent—The Secretary.

Official Publications Received

Great Britain and Ireland

Royal College of Surgeons of England. Scientific Report for the Year 1936-1937. Pp. 40. (London: Royal College of Surgeons of England.) [1511]

Board of Trade. Statistical Abstract for the British Empire for each of the Ten Years 1927 to 1936 (Trade and Commerce Section). (No. 60.) (Cmd. 5582.) Pp. xv + 229. (London: H.M. Stationery Office.) 3s. 6d. net. [1511]

ULAWS Monographs and Reports, No. 2a: Report of a Discussion on the Destruction of Sea-Birds by Oil Waste, held at University College, University of London, on May 10, 1937. Pp. 16. (London: University of London Animal Welfare Society.) [1511]

Twenty-one Years: a Professor looks out on the Glass Industry. Being the Presidential Address delivered on the occasion of the Twenty-first Anniversary Meeting of the Society of Glass Technology, at Sheffield, November 9th, 1937. By Prof. W. R. S. Turner. Pp. 70. (Sheffield: Society of Glass Technology.) 10s. [1511]

Science Museum: Board of Education. Catalogue of the Atom Tracks Exhibition (November 1937—February 1938). The Results of 25 Years of Research by Prof. C. T. R. Wilson's Expansion Chamber Method, in which the Tracks of Individual Atoms and Electrons are rendered Visible and Photographed. Compiled by Dr. F. A. B. Ward. Pp. 28. (London: H.M. Stationery Office.) 6d. net. [1511]

Other Countries

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ended June 30, 1936. (Publication 3405.) Pp. xiv + 446 + 122 plates. (Washington, D.C.: Government Printing Office.) 1.50 dollars. [1511]

Indian Forest Records (New Series). Vol. 3, No. 4: Entomological Investigations on the Spike Disease of Sandal (32) *Lygaeidae* (Hemipt.). By N. C. Chatterjee. Pp. 105-122. 8 annas. Vol. 3, No. 5: Cik Latr. et Anobides nouveaux des Indes (Coleoptères). Par M. Pic. Pp. 123-126. 3 annas; 4d. Vol. 3, No. 6: Immature Stages of Indian Coleoptera (22). By J. C. M. Gardner. Pp. 127-140. 12 annas; 1s. 3d. (Delhi: Manager of Publications.) [1511]

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 38: Technological Reports on Trade Varieties of Indian Cottons, 1937. By Dr. Nazir Ahmad. Pp. v + 145. (Bombay: Indian Central Cotton Committee.) 1.8 rupees. [1511]

Queen Victoria Memorial, Salisbury. Annual Report for the Year ended 31st March 1937. Pp. 8. (Salisbury, S. Rhodesia: Queen Victoria Memorial.) [1511]

South African Institute for Medical Research. Annual Report for the Year ended 31st December 1936. Pp. 64 + 2 plates. (Johannesburg: South African Institute for Medical Research.) [1511]

Proceedings of the United States National Museum. Vol. 84, No. 3023: On the Detailed Skull Structure of a Crested Hadrosaurian Dinosaur. By Charles W. Gilmore. Pp. 481-492. Vol. 84, No. 3022: Annotated List of West Virginia Mammals. By Remington Kellogg. Pp. 413-480. (Washington, D.C.: Government Printing Office.) [1511]

Catalogues, etc.


Mull Recording Microphotometers. (MF 97.) Pp. 12. (Delft: P. J. Klipp and Zonen.)

Calendar for 1938. Pp. 32 + 32 + 32 maps + Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

Books for Presentation. (Catalogue No. 543.) Pp. 60. (London: Bernard Quaritch, Ltd.)

Kodak X-Ray Materials and Accessories. Pp. 40. Kodak X-Ray Reduction Camera. Pp. 8. (London: Kodak, Ltd.)

Zeits. Nachrichten. Sonderheft 2, August 1937. Pp. 48. Folge 2, Heft 3, August 1937. Pp. 61-112. (Jena: Gustav Fischer.)

Editorial & Publishing Offices : MACMILLAN & Co., LTD. ST. MARTIN'S STREET LONDON, W.C.2		LIBRARY Telegraphic Address : PHUSIS, LESQUARE, LONDON Telephone Number : WHITEHALL 8831
No. 3556	SATURDAY, DECEMBER 25, 1937	Vol. 140

Location of Industry in Great Britain

THE astonishment and uneasiness with which the evidence given by the Board of Trade to the Royal Commission on the Geographical Distribution of the Industrial Population at its fourth meeting has been received is an indication of how far the old ideas of *laissez-faire* have been left behind. The policy of do-nothing which the Board apparently follows is as unsuited to the present day as it is inconsistent with the general tenor of the Government's active intervention for the promotion of industrial and social well-being. Already Government policy is influencing the location of industry in many indirect as well as direct ways. The making of the Great West Road out of London, the electricity 'grid', the transference of workers, and the housing subsidy are some of the means already used to direct the location of industry away from old to new industrial areas, and are sufficient in themselves to invalidate the complacent view put forward by the Board of Trade.

The whole problem is one to which scientific workers may well give their attention; and welcome evidence that they are doing so is afforded by the meeting recently devoted by the Institution of Chemical Engineers to the Special Areas of England and Wales, at which Mr. C. H. Boyd gave an account of some technical and economic aspects of the Commissioner's work.

Mr. Boyd's survey showed clearly the great progress which has been made in the Special Areas in improving the local services in co-operation with the local authorities and other similar bodies. Arrangements have been made in all the areas whereby the industrialist can be provided, by the trading estates companies in the north-east and in South Wales and by the Industrial Development

Company in West Cumberland, with up-to-date factories of standard type either on the trading estates themselves or by arrangement with the Commissioner in other parts of the areas. The new policy of industrial development is already showing encouraging results, and is assisted by the fact that the areas are now in a position to provide a much more attractive market for the new and lighter industries than they have been for some years.

If there is a defect in Mr. Boyd's paper, it is that, before a technical audience, he made no reference in an otherwise comprehensive bibliography to the admirable report on Science and Industry of the Joint Committee of the Local Sections of the Society of Chemical Industry, the Institute of Chemistry and the Chemical Society submitted to the District Commissioner in May 1935. This is the more regrettable because the preliminary step to the development of new industries must be research of this kind, and of the type undertaken by Prof. Marquand and his colleagues in South Wales—the application of scientific principles of industrial location to the facts of the distressed areas. We must know precisely what industries can be located profitably in the areas, and what industries can, in general, be located with equal success anywhere.

The improvement which has already taken place in the areas, and the fact that the manufacturer need no longer hesitate to try his fortune in them, should not lead us to overlook the fact that essentially recovery has revealed the bare bones of the problem. It is serious enough that more than 1,300,000 persons should be out of work at the height of prosperity. It is even more disturbing that the burden of unemployment should still

be heavily localized in the distressed areas. The major social problem persists in all the Special Areas. Their industries have in part been scaled down and rationalized, but their labour forces, amenities and facilities are still those designed for the old order when the markets of the world were open.

It is to this aspect of the question that Mr. Donald Tyerman directs attention in a trenchant article in *Lloyd's Bank Monthly Review*. Current conditions of recovery and rearmament have, for the time being, largely solved the cyclical problem. The special and more fundamental problems remain, intensified by the accumulation of derelict people and places, although the liquidation of the areas by scaling down and labour transference has commenced. Recovery in the Special Areas has in fact shown us that we must be prepared for distress at least as severe as ever in the next depression, or we must very considerably accelerate the development in them of new industries.

This is not to invalidate the solutions which are already being attempted: the maintenance of the maximum volume of staple exports by a liberal trade policy, and, if need be, by special aid, to reduce the difficulties of adjustment and liquidation to a minimum; the scaling down of equipment, capacity and labour forces to the maximum which can be employed in the staple industries, involving further extensive reorganization of the coal, cotton and iron and steel industries; and the mitigation of distress by curing, cleaning up and caring for human wastage, by special treat-

ment for aged unemployables and young untrained unemployed. These remain as essential, but the establishment of new industries requires much closer investigation than it has yet received.

It is natural to expect that the Royal Commission on industrial distribution will become acquainted with much of the data and proposals available. Armed with this knowledge, the Government, with the assistance of business men, industrialists and technicians, will be in a position to act. It will at least continue its policy of fixing a magnet in the Special Areas which will overcome such attractions of London and the south as are not based upon their essential requirements or on well-founded economic considerations. If, however, it is to go further by increasing the inducements to new industries in the distressed areas, by multiplying trading estates and increasing the moneys available to the Special Commissioners and the Special Areas Reconstruction Association and by guiding or controlling much more vigorously than hitherto the location of industry, it will need in increasing measure the co-operation of scientific workers. They must accept the responsibility for some measure of the basic work required. The position which many men of science now take in industrial leadership and development places upon them, individually and through their professional associations, the further responsibility for that informed, impartial and creative criticism which is of vital importance to a democratic Government.

A Chemical Encyclopædia

Thorpe's Dictionary of Applied Chemistry

By Prof. Jocelyn Field Thorpe and Dr. M. A. Whiteley. Fourth edition. Vol. 1: A—Bi. Pp. xxvii + 703. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937). 63s. net.

THE appearance of a new edition of "Thorpe" arouses mixed feelings. Chemists will welcome what they know will be a lucid exposition of the latest information regarding a host of chemical subjects, compiled by experts, but this welcome must be tempered by the fact that the authors state it will be nine years before the last volume

is to appear, and, since it is, unfortunately, impracticable to draw up an index in advance, it will be nine years before it is possible to ascertain with any facility what are the contents of the nine volumes. By that time, the present volume will be out of date and, presumably, steps will be taken to issue another edition; in other words, the "Dictionary of Applied Chemistry" is to become a periodical. This method of issue, no doubt, simplifies the work of the publishers, and, possibly, appeals to librarians who prefer to spread their slender monetary resources over a period of years, but it does not yield the best type of book from the user's point of view.

The authors attempt to overcome the difficulty of obsolescence by stating that each substance will be dealt with twice over, once under its own initial letter and again in a general article, the later of the two being the more up to date. Apart from the undesirability of dealing with the same compound twice, all materials are not as accommodating as those mentioned in the preface. For example, in the present volume, "aconitine" has the misfortune to begin with the same letter as "alkaloid" and thus escapes revision.

In spite of the editors' assurance that a new edition is a necessity, some doubt may be felt on the matter. Great as has been the progress of science in the last ten years, the chemistry of 1927 is not obsolete; the old edition of the present work was and still is a most valuable book and a mine of information, but, apparently, it is to be regarded as non-existent, for, among the many hundreds of references, one that never seems to appear is "Dictionary of Applied Chemistry, 1927". Nearly every owner of the new edition is in possession of the old, and there are many subjects of no great general interest—for example, the alcoholometer readings used in different countries—for which a reference to the earlier edition should suffice. Then, as regards newness, a random selection of "anthracene" reveals the fact that about one-eighth of the article contains information obtained after 1927. The proportion for the whole volume is difficult to ascertain, but it would seem to be of this order. If this estimate is not far from the truth, a 'super-supplement' should be sufficient to include all new matter and this could be brought out in one or, perhaps, two years.

With regard to the contents, the first impression is that of a text-book of organic chemistry rather than of a dictionary of applied chemistry. This is, perhaps, due to the lavish provision of structural formulæ, the comparative scarcity of diagrams of plant and the almost complete absence of flow sheets. No one will deny the undesirability, and, indeed, the impossibility, of divorcing technical chemistry from its underlying fundamental principles, but it is manifestly impossible to cover the whole of modern chemistry, even in nine volumes, which implies that something must be left out. There is a great need for a really good reference book on applied chemistry in the English language, and little harm would be done if much of the purely theoretical matter in the present volume were omitted and more technical details were included. The former matter is readily found in journals; the latter is much more difficult of access, although, fortunately, not so difficult as in years gone by, when every process was regarded as secret. As an example, the space occupied by "atlantone" is almost exactly equal to that

devoted to the manufacture of absolute alcohol. Much of the organic matter may be criticized for its text-book style of presentation. It is an exception for yields to be mentioned, although it must be recognized by now that the yield obtained by a given process is not only of vital importance to the manufacturer, but is also of the utmost value in determining the mechanism of the reaction.

The article on "analysis" has disappeared, but there is a hint that this is to be replaced by one on "chemical analysis". It is questionable whether too much space has not been devoted to this subject. With the exception of certain valuable tables, the information given is usually insufficient to enable an analysis to be conducted and could be curtailed. An example of how this may be done is to be found under "Aluminium, detection and determination of"—a most admirable summary.

The general articles are of interest, but the desirability of including them is doubtful; bound together in a separate volume, they might appeal to many, but in their present association they are apt to be overlooked, particularly without an index. How many people requiring information on the weathering of paints would look for the word "ageing", and who would turn to a dictionary of applied chemistry for details of precision weighing? It is suggested that future volumes should give a list of these special articles with a brief indication of their contents. Incidentally, the author of the article "balance" mentions Aston's microbalance for gas densities, but does not refer to the far superior type of Whytlaw-Gray.

It is difficult to discuss individual articles. Of these, the most outstanding are "aluminium", "autoclave", "acetylene", "absorption" and "adsorption". A few omissions and errors have been noticed. The methods given for preparing esters of acetic acid are certainly not those of 1937, the azeotropic process not being mentioned. Austenite is dismissed in thirteen lines. The yield of acetic acid obtained by the distillation of wood is said not to vary greatly with the species of tree, a statement incorrect even for hard woods. The erroneous combination *carum ajowan* is given for the ajowan plant and ascribed to Bentham and Hooker, the correct name being *Trachyspermum Ammi* (Link) Sprague. Finally, the process of manufacture of the important pigment, antimony oxide, is not mentioned, while the conditions of interconversion of the two oxides are not made clear.

Minor defects such as these are unimportant when compared with the value of the book as a whole. If the subsequent volumes are as good as the laboratory and more of the same kind, the will be still greater.

Academic Spiritualism

(1) Some Cases of Prediction:

a Study. By Dame Edith Lyttelton. Pp. 160. (London: G. Bell and Sons, Ltd., 1937.) 2s. 6d. net.

(2) Personality Survives Death

Messages from Sir William Barrett. Edited by his Wife. Pp. xlvii + 204. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 7s. 6d. net.

(3) The Superphysical:

a Review of the Evidence for Continued Existence, Reincarnation, and Mystical States of Consciousness. By Arthur W. Osborn. Pp. xvi + 350. (London: Ivor Nicholson and Watson, Ltd., 1937.) 12s. 6d. net.

WITHIN recent years, a distinct change in the character of spiritualistic propaganda has become discernible. A division is becoming apparent and, if we may be pardoned for using a current political expression, its exponents are becoming somewhat 'class-conscious'. The extent and crudity of the fraud now being practised both in Great Britain and in the United States have almost forced the more educated classes to eschew what is presented for the edification of their weaker brethren, and to build up something more in accordance with their own intellectual standards. Propaganda is to-day of a much more sophisticated type; and the language of modern psychology and statistical method is supplanting the naïve descriptions of earlier years.

(1) Dame Edith Lyttelton, in her study of some cases of prediction, has written a disarming introduction to her collection, since she shows herself fully aware of the objections which are naturally aroused by her narrative. Passing from cases which she admits might be due to coincidence, she proceeds to more detailed instances which can, she thinks, only be understood if we assume what she calls "precognition". Yet on a careful reading of her records the student cannot fail to be assailed by the feeling that, even in the most detailed cases, a normal explanation would suffice were the facts more fully known and reported in a more strictly scientific spirit. Sometimes the central point of the story seems awry, as when a seer, seen as in a vision with a scar over his left eye, in a letter to Dame Edith writes that his friend did not have a scar over his

left eye, whereas the fact was that the scar in question was under the right eye.

(2) From cases of prediction, premonition and extended telepathy, it is easy to consider messages from the dead, and Lady Barrett has thrown down the challenge boldly when she entitles her collection of communications purporting to come from the late Sir William Barrett, "Personality Survives Death". These messages, mainly delivered through the mediumship of Mrs. Osborne Leonard, are strikingly illustrative of the theory which regards the building up of the characters of the deceased personalities as due to the dramatic powers of the medium, who adopts histrionic poses the material for which may be derived either from normal sources or in some other and unknown way. Mingled with this material we find much more which is probably derived from the medium's own mental content, thus suggesting that the effort of sustaining a prolonged dramatization may be severe. However that may be, Lady Barrett appears satisfied that the communicator is really the person he purports to be; and some of the trivialities and intimate details brought out at the sittings are certainly reminiscent of the late Sir William.

As a serious contribution to spiritualistic literature the book is clearly one which shows how much work remains to be done before we can hope to obtain any clear idea of the nature of the mental processes occurring with a reliable trance medium. Indeed such a task becomes more important when we turn to (3), Mr. A. W. Osborn's study on the "Superphysical", for it is here that we can discern the direction in which modern academic spiritualism is drifting.

In the introductory section to his book, Mr. Osborn discusses and analyses current scientific and psychological ideas, laying stress upon whatever, in his opinion, counteracts the influence of materialism. He then proceeds to pass in review the so-called supernormal phenomena of spiritualism and psychical research, in this part of his book displaying a singular lack of critical appreciation of the material with which he deals. Finally, he attempts to show that an acceptance of the facts alleged in the preceding sections, together with an understanding of the implications involved in the philosophic ideas advanced by certain modern physicists, necessarily lead the student to a fuller realization of mystical states of consciousness and thence to a new order of living.

It is here that we can see the link which is tending more and more to unite those who previously had but little interest in spiritualism regarded as a religion. The phenomena of prediction, the supernormal aspect of which is so sincerely sponsored by Dame Lyttelton, suggests the necessity for radical changes in our psychological approach to problems of human personality which, Lady Barrett assures us, survives death; whilst Mr. Osborn, accepting both

these claims, continues the work by pointing out how such facts lead to a new conception of life and death. Were the alleged facts, however, to be substantiated, it is doubtful whether their interpretation would tend in the direction indicated by Mr. Osborn; and it can scarcely be admitted that the fresh evidence now advanced by Dame Edith Lyttelton and Lady Barrett is more striking than much already printed elsewhere.

Conservation of Wild Animal Life

The Animal Year Book:

Vol. 4. Edited by Dr. H. E. Bargmann. Pp. vi + 174 + 10 plates. (University of the London Animal Welfare Society, 1937.) 2s. 6d.

ALL, surely, will agree with the contention, made in the preface to this review of the work accomplished by the University of London Animal Welfare Society during 1937, that "The progress of the movement for animal welfare, both at home and abroad, depends very largely on arousing the interest of the rising generation in its problems".

Two such problems of the very first importance are placed in the forefront of this review. The first, under the title, "The Tragedy of the Possum", reveals the appalling slaughter that has taken place of the common opossum (*Trichosaurus vulpecula*) to supply the insatiable demands of the fur-trade. Mr. David Stead, a well-known Australian naturalist, takes his evidence mainly from Government reports, hence he may be acquitted of bias, or of speaking without authority. Legislation for the protection of this animal now exists in all the States of Australia, but it has been of slow growth, though quickened by the statistics for the year 1919-20 when no less than 7,500,000 were sent to the markets. The attempt to curb this waste of life, made by the Governments in the form of 'close seasons', has proved ineffective, since animals killed during the close season in one area are sent into a neighbouring State to be passed out as the harvest of its open season!

Various subterfuges are resorted to for the purpose of justifying 'open seasons'. But it seems clear that unless the slaughter of this animal for trade purposes is prohibited altogether, its extinction in the very near future is assured. Mr. Stead points out that "Australia has a unique heritage for which it must accept responsibility", and continues, "Is it too much to hope that public opinion which urges that trusteeship of this fauna

shall become active and real, can supply the force to set the machine in effective and permanent motion?"

The second of these problems is ably set out by Mr. A. H. Kirkman. In concerns "Africa's Vanishing Fauna", and the alarming rate of the disappearance of the 'game animals' of Africa. The blaaubok (*Hippotragus*) and the quagga have already vanished. Only a few skins in museums are left to tell us what they were like. Of the mountain zebra only two herds of twenty or twenty-five are known to exist, on farms, and these are being zealously guarded. The same is true of the bontebok, of which species two herds only, of forty-four and twenty-five respectively, now exist, and under private ownership. Of that extraordinarily interesting antelope the white-tailed gnu, it is estimated that no more than about three hundred remain of the hordes that existed before the advent of the Dutch settlers. The survival of the Cape hartebeest is now precarious, and the sable antelope is in danger of extinction. But we should like to know on what authority the statement is made that the elephant "still exists in several tens of thousands".

The difficulties which confront the game-wardens, where they exist, in the preservation of the animals of Africa in their respective areas of control are great. This is largely due to the fact that the natives now possess fire-arms. A further factor in this alarming progress of extermination is the slaughter carried on for the avowed purpose of exterminating the tsetse-fly and the carriers of sleeping-sickness. The annual report of the Southern Rhodesian Government for 1931 shows that during the year a grand total of 12,000 animals were slain in this effort, which is impossible. If, and when, the last of the tsetse-fly animals in the haunts of the tsetse-fly are exterminated, sleeping-sickness will be a thing of the past, and the tsetse-fly will be a thing of the past.

in the blood of numerous species of small mammals the extinction of which would be impossible. Those who wish to read the full story of this rapidly increasing march of destruction would do well to read Mr. Kirkman's admirable summary.

With the issue of the fourth volume of "The Animal Year Book", the editorship passes into

the efficient hands of Dr. Helene E. Bargmann. As is inevitable with a change of editorship of such a publication, this issue is largely occupied by the effort to clear up arrears of accepted matter. The new editor is to be congratulated upon having executed this difficult task with patience and discretion.

W. P. P.

Polynesia through Many Eyes

Religion and Social Organization in Central Polynesia

By Robert W. Williamson. Edited by Dr. Ralph Piddington. Pp. xxx + 340. (Cambridge: At the University Press, 1937.) 25s. net.

THE curiosity which Polynesia excited in the eighteenth and nineteenth centuries was not of the scientific kind which searches for facts on which to base generalizations; it was the curiosity of dilettantes. Explorers, sailors and missionaries did not pursue their inquiries to the point at which they would begin to demonstrate but cease to amuse, nor were they prepared to subject the blossoms of imagination to the icy blasts of scientific criticism. To entertain they had to be intelligible, and to be intelligible they had to transpose Polynesian customs into a European mode. The European mind was imbued from childhood with Greek mythology, so Williams arranged the Fijian gods into a pantheon on the Greek model, an arrangement more convenient than true.

Deification was familiar from the history of Rome, so Polynesian theology was reduced to deification. The Polynesian gods were supposed to be deified chiefs, and they were stated to be so as a fact. Now deification is a ceremony, and no such ceremony has ever been recorded in Polynesia, nor is there any word in the language which could by stretching its meaning be translated deification. The facts are that every deceased has power and so may become the object of a cult, which may or may not persist according as he proves effective or not. A dead chief has more power than a dead commoner, and so has a better chance of surviving in the memory of the people.

The distortion of the facts was still further increased when the naturalism of Greek mythology was combined with misunderstandings of Roman religion. The French missionaries believed that in Mangareva "all the principal phenomena of nature were deified as good or evil spirits, inspired hope or fear" (p. 26). They proposed at least four theories: of the nature of deification,

of a theological dualism, of a hierarchy of phenomena. Every one of these theories requires to be supported with the evidence of facts, the facts being the actions and words of the Mangarevans; but the good missionaries were there to convert heathens, not to prove theories; and they cannot be blamed for not even distinguishing between facts and theories. The anthropologist should know better, because it is his business to make a distinction, without which science is impossible.

Mr. Williamson, however, was far too modest to distinguish when his masters had not done so. He was far too diffident and too kind to reject any of his witnesses. Equal weight is given to all, and if *X* asserts the opposite of *Y*, the contradiction does not seem to impair his faith (for example, p. 123). Mr. Williamson is more than impartial; he is neutral. The only witnesses that do not benefit by this neutrality are the natives. Wilkes, a passer-by, is allowed to depone as to the meaning of the Samoan word *atua*, but not the Samoans, though their evidence was recorded verbatim in *Man* in 1915 (p. 12).

This neutrality had been a tradition too long for Mr. Williamson to break away from it. He had patience, honesty, thoroughness and industry, and a preference for safety. It was not safe to introduce into anthropology the distinction between the observed facts and the interpretation of those facts. It would have meant scrapping ruthlessly, as unfit for scientific consumption, masses of travellers' tales, amateurish speculations, careless observations, misunderstandings and mistranslations and faults of memory which had been passed by generations of anthropologists. Mr. Williamson is not the only one who quailed at this sacrilege. Rivers is almost the only one who did not.

What Mr. Williamson had not the courage to do the reader will have to do for himself; he will have to sift the material. To do so he will probably find himself compelled to go to the originals. Mr. Williamson has provided him with an exhaustive catalogue and a conscientious guide.

A. M. HOCART.

Handbuch der Anorganischen Chemie
Herausgegeben von Prof. Dr. R. Abegg, Dr. Fr. Auerbach und Dr. I. Koppel. In 4 Bänden. Band 4, Abteilung 3: Die Elemente der achten Gruppe des periodischen Systems. Teil 4: Nickel und seine Verbindungen. Lief. 1. Herausgegeben von Dr. I. Koppel. Pp. xviii + 827. (Leipzig: S. Hirzel, 1937.) 78 gold marks.

THE literature relating to any one of the chemical elements is now so great that scientific workers in general should be grateful for comprehensive works such as the volume under review, which save them much labour in their search through numerous and scattered original publications. In the English language we now have the recently completed "Comprehensive Treatise on Inorganic and Theoretical Chemistry" by J. W. Mellor which fulfils this need, whereas in German there is not only "Gmelin-Kraut's Handbuch der Anorganischen Chemie" and the handy "Lexikon der Anorganischen Verbindungen" of M. K. Hoffmann but also "Abegg's Handbuch der Anorganischen Chemie", of which the present volume constitutes a part.

The Abegg series of handbooks enjoys a well-deserved popularity as works of reference. This appreciation is due not only to the comprehensive nature of these volumes but also to the clarity and logical order of their subject matter. The present monograph on nickel maintains fully the high standard of the foregoing volumes, and is to be warmly recommended to all inquirers interested in this element, which is important for both technical and scientific reasons. Nearly one third of the 827 pages of this treatise is devoted to the preparation and properties of the metal, and about an equal amount of space is allotted to nickel compounds, including univalent, bivalent and trivalent derivatives, simple and complex salts, amminated derivatives and complex compounds with organic addenda. Other sections include data on the atomic weight of nickel, the physics of the nickel atom and the colloidal properties of the metal and certain of its derivatives. These topics are surveyed with all the thoroughness usually displayed in this series of treatises.

This volume, which is fully documented up to 1936 and printed clearly on durable paper, is largely free from errors. There are, however, two criticisms which the reviewer wishes to make. The first is the absence of an index. This omission is offset to some extent by a good table of contents at the beginning of the volume and by the orderly arrangement of the text, which follows closely the periodic arrangement of the elements. The second criticism relates to the high cost of the treatise, which at the existing rate of exchange places it beyond the reach of many chemists.

F. H. B.

Wide Horizons:

Wanderings in Central Australia. By Robert Henderson Croll. Pp. xiv + 158 + 27 plates. (Sydney and London: Angus and Robertson, Ltd., 1937.) 9s. 6d. net.

MR. CROLL records impressions of Central Australia, which were gathered on four expeditions between

1929 and 1934. He witnessed both the effects of a seven years drought and the rejuvenation of the country and its animal and vegetable life after the rains. The contrast is strikingly portrayed, though, not unnaturally, the narrative stresses the aridity of the dry period. The author conveys to his readers the charm and beauty of the landscape as effectually as he impresses upon them the vastness of its spaces. He is an enthusiast on the economic possibilities of the country, given a water supply and a market such as a newly discovered gold-field might afford.

The concluding chapters deal with the problem of the aboriginal and the half-caste. Here the indictment of the Australian people is mainly in the form of a statement of fact, and is temperate in language. It is all the more telling for that. While recognizing the beneficent work of the missionaries, he holds that humanitarian measures have been no less a failure in the long run than neglect; and that what is needed is a drastic change in method, liberal expenditure in money, and Federal control (see NATURE, Dec. 18, p. 1029).

Duše Rostlin (The Soul of Plants)

By Prof. B. Němec. Pp. 234 + 16 plates. (Prague: Nakladatelství Pražské Akademie Tiskárny, 1937.) 29 crowns.

PROF. NĚMEC, the distinguished Czechoslovak plant physiologist, has written an absorbing survey of the plant kingdom under the title "The Soul of Plants". Writing for men of science in general, he describes plant-life, the evolution of higher forms, the struggle for existence and the purposefulness of their life-cycles. There is a particularly striking chapter, "Death rules the Living", which gives a vivid idea of the contributory causes for the 600,000 plant species and of the genetics of the 'miracle of inheritance', the sources of variation, genes and the ways in which plant posterity is ensured.

It is to be hoped that an English edition of this work will appear, so that Prof. Němec's views may reach a wider circle of readers.

Biological Laboratory Technique:

An Introduction to Research in Embryology, Cytology and Histology. By Prof. J. Brontë Gatenby. Pp. vii + 130. (London: J. and A. Churchill, Ltd., 1937.) 7s. 6d.

THIS book gives a short introduction to recent methods in microtomy, many of the methods being adapted for the smear technique which does not require section cutting. It is a useful and compact summary for amateurs who do not have an elaborate equipment and for university students and teachers desiring an introduction to the most recent practices. In addition to a statement about apparatus, the treatment of living cells and vital staining, there are sections on smear methods, fixation, embedding in paraffin, dioxan, *n*-butyl alcohol and celloidin. A chapter on staining is followed by notes on methods in histology and embryology.

Apparent Enlargement of the Sun at the time of Rising and Setting

By Dr. Vaughan Cornish

IT is a matter of common observation that when the sun is nearly on a level with the eye and is in the vicinity of the horizon its apparent size

ment, or any intention of subsequent measurement, but from known view-points, so that the angular magnitudes of terrestrial features were afterwards ascertained from the map.

The sun seen from Bern rising above the Bernese Alps forty miles away, measured 0.16 inch on a 7-inch page. As seen from Grindelwald the sun rising above the Wetterhorn four miles away measured only 0.9 inch on a 7-inch page. These measurements seem at first to confirm the expectation that the sun would be apparently enlarged in proportion to the diminution of terrestrial features by greater distance. When, however, I measured the mountains in the two drawings and compared

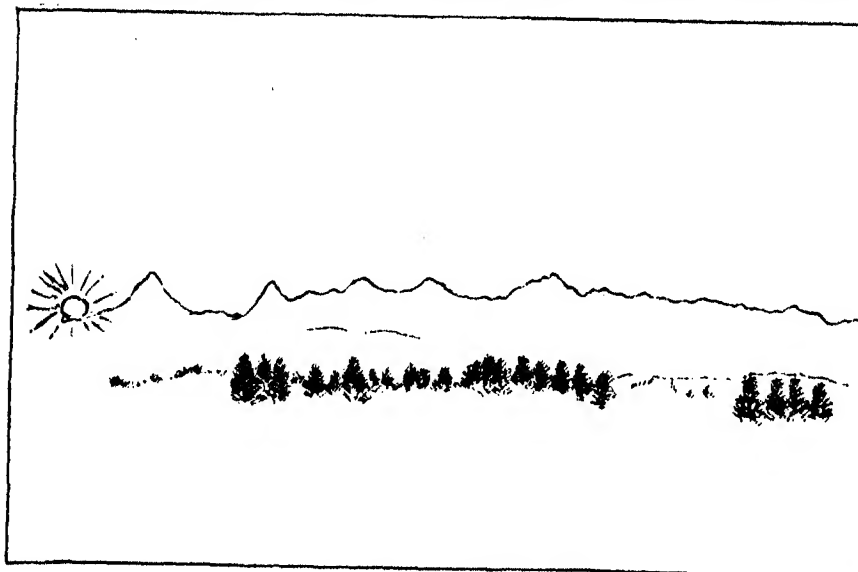


Fig. 1.
THE RISING SUN FROM BERN

is greater than when high up in the sky. It is generally assumed that this is due to the circumstance that the features of the skyline provide a true standard of instinctive comparison which enables the eye to appreciate the angle subtended by the sun's disk. It is true that the linear magnitude of the terrestrial features is fairly well known and that the tone and other qualities of the horizon give an instinctive impression of its distance. The current explanation breaks down, however, under the test of actual measurement of the apparent magnitudes. These measurements are trustworthy only if made by an indirect method which sidetracks the critical faculty, for as soon as thought comes into play, the spontaneous impression of magnitude is impaired. The measurements in question have been made from a number of

places which I have made during the last few years. All drawn originally without measure-

ment, or any intention of subsequent measurement, but from known view-points, so that the angular magnitudes of terrestrial features were afterwards ascertained from the map. I found that the apparent magnitude in the more

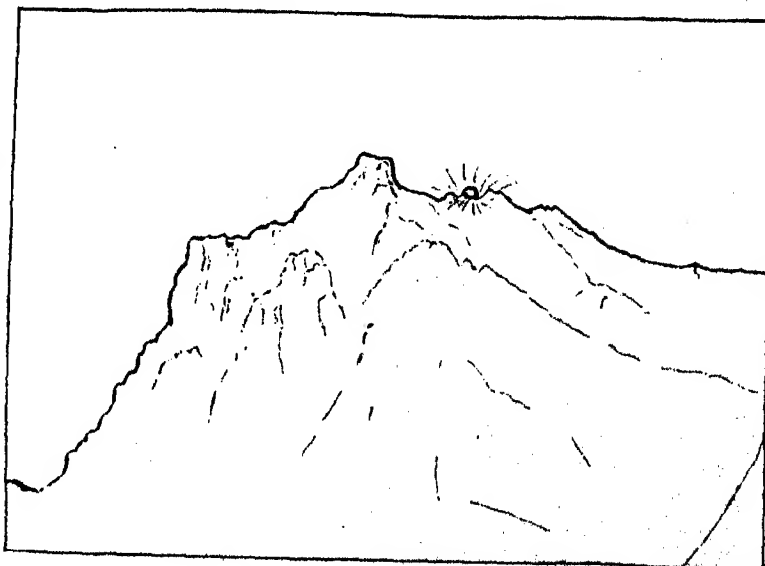


Fig. 2.
THE RISING SUN FROM GRINDELWALD

distant view was not reduced proportionately to the distance, but on the contrary was subjectively

magnified. The arc of horizon comprised in the sketch made at Grindelwald was 34° ; that from Bern, 21° . Thus the subjective enlargement of the mountains seen from Bern was 1.6, that of the sun being 1.7, which for this class of observation is practically identical.

Following up this clue, I measured drawings of the arc of the horizon included in a page of my sketch-book when drawing the long line of comparatively low hills on the west of Bournemouth Bay, and the lofty mountains enclosing the valley of Lauterbrunnen. I found that whereas the impression of lateral extent received in the former case was the greater, the arc of the horizon comprised in the panoramic sketch was much less, that is, the eye was sooner satisfied when it had to deal mainly with one dimension.

Referring again to the small apparent size of the sun when rising above a crest-line something like 20° above the line of sight, that is, above the Wetterhorn seen from Grindelwald, it will be noted that the features of the view are not strung out in a narrow horizontal band as when the range of which the Wetterhorn is a member is

viewed from Bern forty miles away. It seems, therefore, that the more the eye takes in vertically the more it takes in horizontally and the less imposing are both dimensions.

These indications led to an interesting result on measuring drawings which comprised the peaks of Eiger and Mönch seen from Gurten-Kulm and from Kleine Scheidegg, distant respectively about 37 and $2\frac{1}{2}$ miles. From the former position, the arc of the horizon in the page of the sketch-book was $18\frac{1}{2}^\circ$; in the latter $60\frac{1}{2}^\circ$. The peaks seen from Kleine Scheidegg stood about 26° – 27° above the line of sight. These measurements explain the familiar sense of disappointment experienced on near approach to mountain peaks the great magnitude of which has impressed the mind when viewed from a distance. As we approach the mountain the field of attention steadily expands without, however, any warning sensation in the eye. Our field of attention varies according to circumstances and the mind transfers the change of magnitude to the objects in the field, but in the reversed sense, an actual restriction of the field being accompanied by apparent enlargement of the objects viewed.

Expedition to Baffin Bay, 1937

AN expedition, led by J. M. Wordie of St. John's College, Cambridge, has returned from a three months voyage to Davis Strait and Baffin Bay. The party, ten in number, had as its main objectives the geology and archaeology of Ellesmere Land and the investigation of the upper atmosphere by free balloons. The Norwegian motor-sealing vessel *Isbjørn*, of Tromsø, 172 tons, carrying a crew of twelve, was specially chartered for the expedition, and sailed from Leith on June 27, returning on October 1. H. Carmichael and E. G. Dymond, who was assisted by I. M. Hunter, made cosmic ray investigations with high-altitude balloons near the magnetic pole. Eskimo anthropology and archaeology were studied by T. C. Lethbridge and T. T. Paterson, assisted by R. W. Feachem and D. Leaf; geology, petrology and physiography by Paterson, H. I. Drever and A. H. Robin; and botany by Feachem.

The year was exceptional in that no ice was met with in Melville Bay, and the ship was able to proceed as far north as Bache Peninsula in Ellesmere Land without ice hindrance; the Middle Pack, which usually occupies the west side of Baffin Bay, and is fed from Smith Sound and

Lancaster Sound, was nowhere seen. This lack of ice, though it gave unusual opportunities for archaeological work and geographical exploration, had the disadvantage that no large floes were available out at sea as launching grounds for balloon flights, and cosmic ray work was therefore confined to the West Greenland coast.

The cosmic ray experiments involved the measurement of the intensity of the radiation at great altitudes in the polar atmosphere, and instruments were conveyed to heights of more than 25 km. by free balloons, utilizing the methods of Prof. E. Regener of Stuttgart. Two types of apparatus were used, one designed and constructed by Carmichael in the Cavendish Laboratory, Cambridge, consisting of a pressure ionization chamber and electrometer with photographic recording of the ionization, pressure and temperature, and the other, by Dymond in Edinburgh and J. A. Ratcliffe in Cambridge, a triple-coincidence counting set with wireless transmission of the counts and the barometric pressure. In addition, the intensity of the cosmic rays at sea-level was recorded by two ionization instruments, one lent to the expedition by Regener and Hoerlin,

the other by Millikan and Neher. Two flights with Carmichael apparatus were made and four with Dymond apparatus. Both the Carmichael instruments were recovered with their photographic records, and coincidences were counted to considerable altitudes on three of the Dymond flights. One Dymond apparatus to which a recording Bosch meteorograph had been attached was also recovered.

To test wind conditions, pilot balloons were released on every possible occasion, balloons of larger type than usual being used so as to obtain a rapid ascent to great heights. The rate of ascent, about 21 km. per hour, was reliably determined

particular attention being given to work at Turnstone Beach, Buchanan Bay, Ellesmere Land and at Cape Hardy (Cape Sparbo), North Devon. They have brought back a very fine collection which far exceeds any previously made in this part of Arctic Canada, and which it is hoped will determine the early material culture of the Eskimo who crossed Smith Sound into Greenland about twelve hundred years ago.

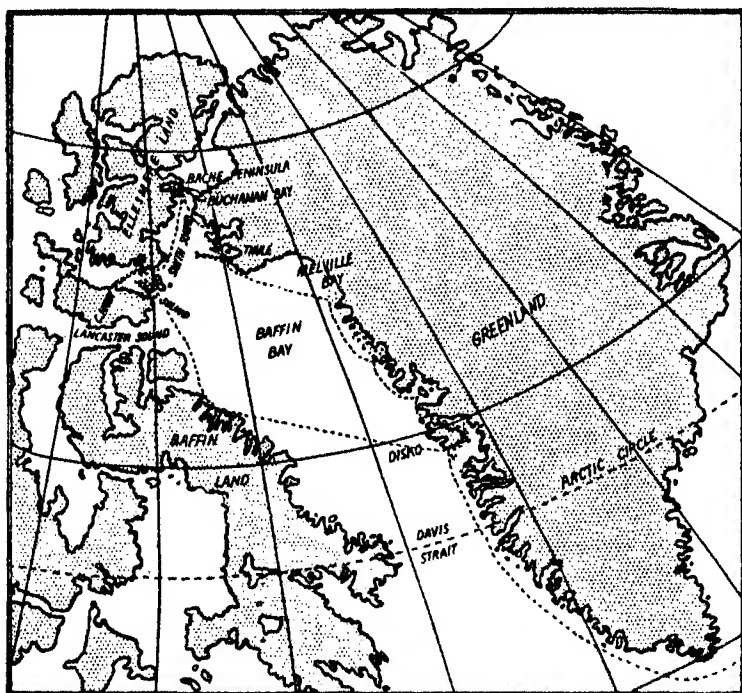
The geological results were also very satisfactory. In West Greenland, north of Disko Island, sills and dykes were discovered, traversing the Tertiary basalt lavas and showing a differentiated series with banded gabbros and allied rocks,

recalling the Tertiary material found by Wager and Deer at Kangerdluaksuaq, East Greenland, in 1935-36. The Thule sediments of North-west Greenland were traced into Ellesmere Land and found to pass conformably upwards into Lower Cambrian rocks with a trilobite and brachiopod fauna. This series was also found as far south as Jones Sound, proving a greater extension into Canada than was hitherto suspected.

On the return voyage, unexpected geographical discoveries were made in North-east Baffin Land, which was found to be a region of long fjords penetrating a glaciated mountain area south-westwards into hill country of low relief. This region was probably familiar in part to Dundee whalers last century, but its extent and variety were quite unexpected. New fjords and islands were discovered, and of the fjords six are 40-60 miles in length, while there are

many others of shorter extent. The fjords themselves are steep, with mountain walls 2,000-2,500 feet in height. By contrast, the land beyond is open and not unlike Scottish moorland country, and at one time must have carried a plentiful reindeer stock.

A running survey was made of the new land, using sextant and range-finder methods with the ship's course as base, and in this way more than 600 miles of new coast-line were successfully mapped. The work had to be done quickly late in the season, and was carried out by the entire party led by Paterson, who selected this method as being the best in view of the limited time available, the persistent low clouds on the mountains, and the sluggishness of the compass near the magnetic pole.



BAFFIN BAY EXPEDITION, 1937. ROUTE SHOWN BY DOTTED LINE.

by synchronized observations with Watts $3\frac{1}{2}$ in. theodolites from the ends of bases of about one mile. In all, twenty-eight pilot balloons were flown, and nineteen were followed to their bursting points, reached from one to one and a half hours after release. The still larger balloons, with apparatus, ascended more slowly and were in the air for three to four hours. The balloon work showed that, in general, during this particular summer the air near Greenland was remarkably still above 20 km. and that, even up to that height, high velocities which were rare. On occasions, balloons ascended almost vertically to their greatest heights. Two whole personnel of the expedition assisted in launching and observing the balloons. The expedition also discovered numerous Eskimo graves in Ellesmere Land and North Devon,

The Standard of Anglo-Saxon Silver Pennies

By Ernest A. Smith

THE Department of Coins of the British Museum was considerably enriched some time ago by the valuable collection of Early English coins, bequeathed by the late Mr. T. G. Barnett, of Birmingham, which includes some five hundred silver pennies of various Anglo-Saxon kingdoms. These begin with a series of Mercia, including fine portrait coins of Offa (A.D. 758-796) of workmanship unrivalled until the reign of Henry VII, and the still rarer portrait coin of his queen Cynethryth, the only queen to appear on coins until Mary Tudor. In describing this collection, Mr. J. Allen¹, keeper of the Coin Department, points out that "the historical value of the Anglo-Saxon coinage lies in the fact that it records rulers otherwise unknown, illustrates by its mints the rise and fall of Kingdoms, and particularly well illustrates the struggle with the Vikings and Danes".

Apart, however, from their undoubted historical value, the large number of Anglo-Saxon pennies included in the collection is of special interest as, incidentally, it raises afresh the question of the fineness of the silver coinage used at that period, as Anglo-Saxon and Anglo-Norman coins are believed to have been made of the same alloy as that now known as sterling silver. This contains 92.5 per cent of silver, and has been the legalized standard for the silver coinage and the manufacture of silver wares in Great Britain for a period now extending well over six hundred years.

This being so, it will not be without interest to consider briefly the available evidence in support of this belief, especially as there appears to be no lack of suitable material with which to confirm it.

During the past fifty or more years, very considerable numbers of Anglo-Saxon silver pennies have been brought to light by the spade. This is perhaps not surprising when we recall that "the increase of mints inaugurated by Aethelred II (866-871) was continued to the end of the Anglo-Saxon period, during all of which time there was a great output of coins, and throughout a general uniformity of style and fabric" (Guesber). A wonderful find was made as early as 1840, at Preston, when a leaden chest was discovered containing no less than 10,000 silver coins, and nearly 1,000 ounces of silver ingots. It is thought to have been the treasure chest of the Danes who were defeated there in 911. Two years earlier, in 1838, some 550 coins were dug up at Gravesend, Kent; and in more recent years smaller lots have been brought to light from time to time. Doubtless

some of these eventually found their way into the melting pot, but in spite of this, many excellent specimens of Anglo-Saxon coins and silver ware are to be found in the British Museum and other museums of the country. It would appear, however, that up to the present, very few of these coins have been subjected to chemical analysis in order to determine their composition, a method of investigation that is now taking such a prominent place in all modern archaeological research. Such few analyses as have been published seem to indicate that the composition aimed at by the Anglo-Saxon coiners was of the nature of a definite standard, which corresponded more or less to the sterling silver of more modern times. Thus, a few coins issued before the Norman Conquest, assayed by the late Sir W. C. Roberts-Austen², chemist of the Royal Mint, gave the following results in regard to silver content. A coin of Burgred, King of Mercia (A.D. 852-874) contained only 33.2 per cent of silver, whilst one of Ethelred (A.D. 978-1016) was found to contain 91.84 per cent of silver, and was probably intended to represent the old standard of England, 92.5 per cent. A coin of Canute (A.D. 1016-1035) proved to be of the standard 93.1 per cent silver, and Roberts-Austen considered was clearly intended to represent the old standard. A coin of William the Conqueror was found to contain 92.3 per cent of silver, and was therefore of sterling quality. Unfortunately, no analyses of Anglo-Saxon silver wares appear to have been made, or if made, have not been published.

At first sight there may not appear to be very much agreement between the figures quoted, but in considering these compositions, it must not be overlooked that the early silver melters were not conversant with the scientific casting technique adopted at the present time to ensure uniformity of composition. Also they had no knowledge of the segregation that invariably takes place when silver-copper alloys solidify, and gives rise to irregularities of composition.

In regard to the adoption of this somewhat peculiar silver standard, Roberts-Austen has pointed out that, in the case of both the gold and silver currency of Great Britain, the adjustment of the relative proportions of the precious and the base metals was undoubtedly guided by the particular system of weights used. In the case of the silver coinage, the fineness of alloys of this metal has from very early times been computed by divisions of the troy pound, which is said to have

been derived from the Roman weight of 5759.2 grains, the 125th part of the large Alexandrian talent, this weight, like the troy pound, having been divided by the Romans into twelve ounces.

There seems to be little doubt, therefore, that there is a distinct connexion between Roman and modern coins and plate, which suggests that the sterling silver was most probably introduced by the Roman coiners. Both Roman and Anglo-Saxon coins and silver wares were undoubtedly made from silver obtained from argentiferous lead by the cupellation process, to which more or less copper was intentionally added to give greater hardness to the metal to enable it better to withstand wear. That the Romans were skilful in conducting the cupellation process is proved by the high percentage of silver contained in many of their earlier issues of coins for which this silver was employed. Gowland¹ has shown that the coins of the Romans, especially during the periods of the Republic, and the Empire up to the time of Nero, and again, with a few exceptions from Constantine to Justinian, frequently contained 98-99 per cent of silver. Much lower percentages, as for example 95 and less, indicate the intentional addition of copper. Some Roman silver coins of the first three centuries, found at Baden-Baden in 1825, when analysed showed a silver content varying from 91.3 down to as low as 50.5 per cent silver. Some of the higher quality coins had the following percentages of silver:

Tragan	(A.D. 98-117)	89	per cent silver
Hadrian	(A.D. 117-138)	88.25	„
Antoninus Pius	(A.D. 138-161)	91.3	„

A coin of the Triumvir Antoninus (31 B.C.) had almost the same composition as British silver coins, as it contained 92.5 per cent of silver, and 7.1 per cent of copper, the remainder being gold and lead.

The differences shown in these figures are no doubt partly accounted for by the fact that the Romans adopted the method of casting their coins for the sake of cheapness and speed, and in consequence greater irregularities in composition are to be expected than in coins cut from sheet metal.

In this connexion also the assays of Roman silver objects in the British Museum, made by Gowland², are of considerable interest. They gave the following percentages of silver: Spoon, 95.64; dish, 94.30; dish, 92.50; rim of vessel, 95.52; bottom of another vessel, 94.90; patea, 95.15; large dish, 95.09.

As Gowland remarks, "in these assays the proportion of silver present ranges from 92.5 to 95.6 per cent, which would almost seem to indicate that this composition was aimed at by the Romans for what may be termed silver plate, and was of the nature of a definite standard."

The above data are of extreme interest, and although few in number, and not conclusive, they are sufficient to indicate without much doubt that the origin of sterling silver belongs to a much more remote date than is generally supposed. It is a common belief that the introduction of sterling silver dates only from 1300, when it was first legalized as the quality of silver to be used for silversmiths' work. But in the earliest known accounts in which the standard of fineness is mentioned, it is always spoken of as the 'old standard of England', or as 'Easterling silver', thus showing that it had been in use for a considerable time prior to the passing of the Act. As already stated, the coinage of William the Conqueror was of this standard, which may therefore be said to have been in existence, without much interruption, from that time until the present day. Here it may be stated that opinions differ as to the origin of the term sterling, but the explanation found in the oldest records, and now very generally accepted, is that it is derived from the Germans, who were termed Easterlings by the English, from the fact that they lived 'eastward'. The money made by the German coiners was famous throughout Europe for its good quality, and it is said that German melters were fetched over in the twelfth century to improve the British coinage, which at that time had become somewhat debased. The coins made by these melters was termed Easterlings money by the English, but in the course of years, with the propensity for clipping long words, the first two letters were eventually dropped, and thus the alloy became known as sterling silver.

There is little doubt that silver of sterling standard was also used at a very early date for the production of silver wares, and it was only when fraudulent practices increased in their production that it was legalized to protect the honest craftsman and public alike.

The question of its origin is one of more than passing interest, as it concerns an alloy which is produced in considerable quantities annually, and has long been accepted as the most suitable standard for silversmiths' work not only in this country but also in America and elsewhere.

Now that the importance and value of chemical analysis as an indispensable aid to archaeological research is being more generally recognized, it is to be hoped that further analyses of Anglo-Saxon coins and silver objects will be made, so that fresh light may be thrown on this interesting question.

¹ *Brit. Mus. Quart.*, 10, 124 (March, 1936).

² Cantor Lectures on "Alloys used for Coinage", Roberts-Austen, *J. Roy. Soc. Arts* (1934).

³ "The Metals in Antiquity", W. Gowland, Royal Anthropological Institute of Great Britain and Ireland, 1912.

Obituary Notices

Prof. Arthur Hutchinson, O.B.E., F.R.S.

IN the death of Arthur Hutchinson, emeritus professor of mineralogy in the University of Cambridge, and lately master of Pembroke, the science of mineralogy has lost an able exponent and investigator. His distinguished services to his Department, first as demonstrator and lecturer and finally as professor, extended over a period of thirty-six years. His loss is a heavy blow to his profession, his University, and his friends.

That which Hutchinson accomplished during his scientific life divides naturally into two parts, the results of his investigations and his work as a teacher of mineralogy. His first piece of crystallographic research was carried out while he was still a scholar at Christ's College. Afterwards he studied under Emil Fischer at Würzburg. His accomplishments in the field of analytical chemistry are seen in his early work on the mineral stokesite, which he discovered and described. His analysis of this unique and only known tin silicate and the derivation of its formula was performed upon a minute fragment of the only single crystal that has yet been found.

Hutchinson established the chemical formula of the mineral lengenbachite and with A. M. Macgregor he gave a complete account of the composition and optical constants of another new mineral—cornetite. Hutchinsonite, a rare thallium mineral from the Binnenthal, was named in his honour.

Much time and thought was given by Hutchinson to the graphical treatment of problems in crystallography and crystal optics, and we owe to him the stereographic protractor and a crystallographic slide rule, instruments by means of which laborious calculations may be checked or avoided and the problems accurately solved by graphical methods. Later he showed how his stereographic protractor could be adapted to the rapid indexing of the spots of a Laue crystal photograph. In the field of crystal optics Hutchinson's memoirs on the diathermancy of antimonicite are pioneer investigations. Introducing a new method of attack on crystallographic problems, he made an accurate determination of the refractive indices and dispersion of this opaque rhombic mineral for wave-lengths at the extreme red end of the visible spectrum. In these investigations Hutchinson's skill and resource as an experimenter are seen at their height.

Hutchinson excelled as a teacher and he gave unremitting thought and attention to improving the material equipment for his lectures. He constructed with great skill and ingenuity many large crystal models and other apparatus for use in elementary instruction. During the latter part of his career, he devoted much time and energy in the vacations to the care of the large mineral collection, which now became of increasing service in teaching and research.

His genial personality and great capacity for friendship endeared Hutchinson to his colleagues and old

students alike, and the expression of their devotion was signally evoked in the large and representative gathering which assembled to honour him by the presentation of his portrait on the occasion of his retirement from the chair in 1931. He was elected a fellow of the Royal Society in 1922; he also served as president of the Mineralogical Society (1921–24), of which at the time of his death he was foreign secretary.

The period of Hutchinson's professorship (1926–31) coincided with a time of intense activity in research in X-ray crystallography, and he devoted much of his energies towards the organization of his Department to meet the needs both in teaching and research of this rapidly developing branch of his subject. To this time of his tenure belongs the creation of a special lectureship at Cambridge in structural crystallography, and the establishment of a laboratory of crystal physics. These developments foreshadowed the ultimate reorganization of the subject of mineralogy in the Natural Sciences Tripos. The well-equipped new building for mineralogy erected in 1933, and the crystallographic research laboratory, stand as memorials of his life and work.

WE regret to record the death at Warsaw of Dr. Pawal Zada, a young Polish geneticist, who was working in the School of Agronomy of the University of Crakow, in July last, aged forty years. He had made intensive studies of rye and was seeking to produce a variety having six rows of seeds instead of the usual four. He had also studied a disease known as 'brittleness' in rye and showed that it is really a genetic character unaffected by environmental conditions; in his breeding experiments it behaved as a simple Mendelian recessive. He discovered no character of the seed correlated with brittleness, so was unable to find a way of discarding seeds subject to this trouble. As part of his technique he carried out his experiments in special nurseries located in an area of woodland remote from cultivation, so that his plants could be shielded from cross-fertilization from outside sources. Zada was a native of the Ukraine, but he settled in Poland as a refugee, and in his researches he was assisted by his wife, who had been also a fellow student. There was a freshness of outlook and ingenuity in his methods of experiment that promised well for his future had he lived.

WE regret to announce the following deaths:

Dr. N. Gustaf Dalén, inventor of automatic regulators for use in conjunction with gas accumulators for lighting lighthouses and light buoys, for which he received the Nobel Prize in Physics in 1912, on December 10, aged sixty-eight years.

Prof. G. H. F. Nuttall, F.R.S., emeritus professor of biology in the University of Cambridge, on December 10, aged seventy-four years.

News and Views

The National Institute of Industrial Psychology

IN his speech at the annual general meeting of the National Institute of Industrial Psychology held on December 16, Lord Dudley, president of the Institute, referred to the ever-widening field of its work. This was particularly shown in the investigations of environmental conditions in schools. The vocational guidance department has had more demands for assistance in the choice of a career than ever before, the figures for the year being 1278, an increase of 17.5 per cent on those of the previous year. In its industrial investigations, the Institute offers a service to industry which it endeavours to make as complete as possible. While all the Institute's work is approached from a psychological point of view, the part which pure psychology plays varies from branch to branch. Devising selection tests, for example, and finding and ameliorating staff grievances depend almost entirely on psychological considerations. On the other hand, problems of heating and ventilation, of lighting and of movement study, involve largely physiological considerations. Sir John Keane, chairman of the Institute, said that alterations and additions have been made to the Institute's premises, but that there is an urgent need of new accommodation. In speaking of new developments, Sir John referred particularly to the promising start that has been made in the north-western area by the Institute's new branch office in Manchester. It is hoped, he said, to develop in other areas regional sections for membership which might lead to the formation of further branch offices. It is also hoped that in the future the Institute's advisory service on the heating, lighting, and ventilation of schools will be extended to hospitals.

Science and Social Service

IN his address on "Science and Social Service" given to members of the National Institute of Industrial Psychology at the annual general meeting, Sir Richard Gregory stressed the urgent need of the application of scientific method to social and international problems. Although scientific discoveries may be prostituted in the cause of war, it must be acknowledged that the advance of science has on the whole led to an enormous alleviation of human suffering and an increase in the capacity and facilities for happiness. As science is responsible for the industrial developments and economic changes which have caused violent disturbances in our social structure and provided also the means by which civilization may commit suicide, it has a duty to guide the human race in the wise use of the powers it has created. The personal and group loyalties of men, their fears, ideals, passions and ambitions all

lend themselves to scientific study with the view of providing a basis for effective social action. It is fashionable at the present time to blame the machine for the mechanization of life. To do this is to make the fundamental mistake of regarding the machine as the master and not the servant of society, and to forget that the most regrettable results of industrialization are not for the most part the direct fault of technological progress, but of lack of consideration for human needs. One of the prime needs of the present time is the development of research in the social and biological sciences on a scale commensurate with that of the physical sciences. The principal aim of any such studies should be to increase the comfort and promote the intelligence of the worker in order to combat the evils due to conditions arising out of mechanization in industry. Most of the work of the National Institute of Industrial Psychology is designed to this end, and is thus assisting in the adjustment of society to the changes caused by technical development.

New Buildings for the University of London

AN important modification of the building plans of the University of London on the Bloomsbury site is announced. Mr. Charles Holden's original model published in 1932 proposed a building nearly a quarter of a mile long with two towers and long façades on Malet Street and Woburn Square. This was afterwards modified by the introduction of two bays on the Malet Street frontage. The design received almost complete commendation from the lay and professional Press. *NATURE* in an article by "T. Ll. H." published in the issue of July 9, 1932, was the first journal to express misgiving. "Questions of style apart," it was suggested, "air, sunlight, and accessibility are crucial in considering the design. Is it wise, from these viewpoints, to build a single huge building, possibly the largest in London, a break-air, if the word may be coined?" Attention was directed to the difficulty of ventilating a large building and the plea put forward "that the idea of a single great building should be abandoned and an alternative design adopted treating the problem in a more free and characteristic way". This policy has now been officially adopted and a group of buildings surrounding the garden of Torrington Square will be substituted for the northern part of the site. Sites have been offered to Birkbeck College and the School of Oriental Studies. Birkbeck College has in recent years greatly developed its work in scientific teaching and research, particularly for evening students, and will presumably require large laboratories, lecture theatres and other accommodation.

The Metric System and British Export Trade

PRESIDING at a lecture by the Rev. A. J. Stubbs, vice-chairman of the Decimal Association, at the Institute of Export on December 14, Sir Isidore Salmon, M.P., declared that British industry could save large sums of money internally, and increase international trade by millions of pounds a year, if Britain cared to adopt the metric system. "It is unbelievable," he said, "that our own Government has virtually ignored the decimal and metric systems, which are employed by every one of our foreign competitors and many of our Colonies and Dominions. We should in our own interest do all we can to bring before the Government the urgent necessity of appointing a committee to inquire into the whole question." Mr. Stubbs, who before he was ordained, was an electrical and civil engineer, said that of our overseas trade, 64 per cent went to decimalized coinage countries, including about one third of our British overseas markets. The importance of the metric system was also plain, he said, when it was realized that for export purposes we had to manufacture different sizes of machined products, other goods or cartons, and effect intricate internal calculations. It might be said that, to improve export trade, our first duty was to adopt the metric system with its internationally agreed and unalterable values. Mr. Stubbs mentioned that among the influential supporters of a British metric system and decimal coinage were the British Chamber of Commerce, the International Chamber of Commerce, the Federation of British Industries, the Trade Union Congress General Council and the National Association of Head Teachers.

History of Science

THE October number of the *Annals of Science*, a quarterly journal dealing with the history of science, published by Messrs. Taylor and Francis, contains some papers of unusual interest. Prof. J. R. Partington and Dr. D. McKie contribute the first part of their historical studies on the phlogiston theory, dealing with the levity of phlogiston. This theory had a most important influence on the development of chemistry, yet its history is in many ways defective. Prof. Partington and Dr. McKie have made a very detailed and thorough study of the original sources, and show how the idea of the levity of phlogiston developed and what forms it took during the second half of the eighteenth century. Particular attention is given to the views of Guyton de Morveau, a portrait of whom is prefixed to the issue of the *Annals*. Prof. Marjorie Nicolson and Prof. Nora M. Mohler contribute a very interesting study of Swift's "Voyage to Laputa", in which they show how carefully Swift read the contemporary scientific literature and how skilfully he was able to make use of it in his own writings. There are also interesting papers on views concerning the nature of heat and cold, on aqueous vapour and evaporation, on the teaching of the history of science in a women's college in America, and on the Chemical Society of Glasgow.

Early Astronomical Instruments at Oxford

ALTHOUGH a manuscript of 1697 in the Bodleian Library has provided an inventory of the instruments belonging to the early Savilian professors, it is only quite recently that certain of these instruments were discovered to be still in existence and within the walls of the University Observatory itself. In the *Observatory of July*, p. 190, Dr. R. T. Gunther describes four instruments which have been re-assembled from "certain old metal bars and plates" found behind some cases in the University Observatory and brought to the notice of Dr. Gunther by Prof. H. H. Plaskett. These newly discovered instruments are: (1) a 14-in. astrolabe made by Thomas Gemini in 1559 for Queen Elizabeth; (2) a mural quadrant of 6 ft. 9 in. radius made in 1637 by Elias Allen; (3) a 6-ft. iron sextant with brass limb, to be attributed possibly to Elias Allen; and (4) an equatorial quadrant of 2-ft. radius of which the maker is uncertain. In describing these interesting instruments, Dr. Gunther directs attention to the high excellence of Allen's work as instanced by the mural quadrant of 1637, which he divided to give direct readings to 2' and, by means of a diagonal scale, to 12". It is suggested that these instruments were installed by Bainbridge, the first Savilian professor, on whose death they passed as his private property to his successor, John Greaves; in 1659, seven years after the death of John Greaves, the instruments appear to have been given to Oxford by his brother, Nicolas Greaves, in memory of the first two Savilian professors.

Grass Drying

THE development of grass drying since 1927 was discussed by Dr. R. E. Slade in a lecture given to the Institution of Chemical Engineers on December 17. Progress has been remarkable and further advance depends on reducing capital and running costs, designing a plant suitable for small farmers, and improving management so as to ensure a continuous and reasonably steady supply of grass during the growing season. The best plants to-day, said Dr. Slade, can produce high-protein dried grass at an overall cost of £5 a ton, including obsolescence, and this cost compares favourably with that of feeding cakes at the present time. Dr. Slade has recently been experimenting with a simple, inexpensive dryer, workable by one man and suitable for a farm with 50-100 acres of grassland. A single fixed tray, 15 ft. long, 7 ft. wide, with a deep bed of 2½ ft., is charged with grass to a depth of 2 ft. The grass is held down with a hurdle, covered withessian, and heated by furnace gases at 120° C. for 1½ hours; it shrinks 10-12 inches, more grass is added, and the heating is repeated for a like time. The grass, now nearly dry, is tedded and then heated again for 45 minutes. The average air-cycle efficiency during the 4 hours' heating is 76 per cent, and the weight of water evaporated, in a two-day test, was 7.6 cwt. for each cwt. of coke burned. This simple and inexpensive dryer is to be tested further during the coming year.

Artificial Wool Production in Italy

THE manufacture of artificial wool from milk has been successfully started in Italy, and the product known as Lanital has been shown to possess properties suitable for the textile industry. Ninety-four tons of Lanital were produced in 1936 and 760 tons in the first seven months of 1937. The process is based on a patent taken out in 1935 by Comm. Antonio Ferretti, and the plant as installed at the factory of Snia Viscosa at Milan is described in an illustrated article in *Engineering* of December 17. In the process, milk is first deprived of most of its cream, and then chemically treated to coagulate the casein. From vats the casein is transferred to tanks in which are placed water and certain solvents, the result being a viscous substance which can be made into fibres by squirting through fine holes in a spinning nozzle. After passing through an alkaline bath, the fibres in bundles are cut into 'flocks' which after further treatment are dried in steam-heated drying machines, the material then being ready for spinning and weaving into fabrics. It is stated that 'Lanital' has higher heat retaining properties than natural wool and that it can be boiled without loss of weight. Though established to render Italy free from the necessity of relying on outside supplies of raw material, purchases of casein are already being made from Holland and Denmark. It is, however, estimated that the country can supply 20-25 per cent of its wool requirements. At a recently opened exhibition in Rome, a whole pavilion is devoted to the Lanital industry.

Scandinavian Influence in Northumbrian Art

SCANDINAVIAN influence, owing to the Norse occupation, left a deep-seated and long-persistent mark on the life and culture of northern England, which is especially to be noted in art motifs and decorative design at the close of the first and beginning of the second millennia of our era. An interesting and instructive example of this influence is to be seen in the crozier of Bishop Ranulf Flambard, who died in 1128, and whose tomb on the site of the Chapter House of Durham Cathedral was opened in 1878. With his body were found the remains of a pewter chalice, his sapphire ring and his pastoral staff. The ring and staff were exhibited by Mr. T. D. Kendrick at the Society of Antiquaries on December 16. The wood of the staff has perished, but there remains the crook and ferrule of iron. The crook was silver-plated, and had been cleverly and delicately chased with an interlace of slender serpents, the design being inlaid in niello. As Mr. Kendrick pointed out, Flambard had so far identified himself with northern England as to adopt for his crozier the hard and economical ecclesiastical art of Northumbria in preference to the richer style of southern England. Mr. Kendrick went on to show that this ornament was in the characteristic eleventh century Viking style, and must have been made by a smith well practised in making the silver-plated spearheads with niello design of serpents and scrolls, which come chiefly from the Baltic lands. Some of such spearheads had been found in England, and there was

little doubt that Flambard's staff had been made by a Northumberland smith. Though the design was Scandinavian in style and feeling, in detail it showed certain marked peculiarities, which must be regarded as northern English, since they could be explained only as due to a long-established English manuscript style. They were not found in purely Scandinavian art. There was additional evidence for this Anglo-Scandinavian style, as for example in architectural detail at Kirkburn in Yorkshire, which helped to prove its general diffusion.

Health Legislation in Industry

DR. LEONARD P. LOCKHART opened a discussion on the "Wider Issues of Health Legislation in Industry" in the Section of Medical Sociology at the recent annual meeting of the British Medical Association held at Belfast (*Brit. Med. J.*, September 25, 1937). He said that the new Factories Act, in spite of omissions and shortcomings, represents a very considerable advance in social legislation. While certain provisions will act automatically to improve health and safety, there are others that will depend on a high level of co-operation and of common consent to make the result effective. He pointed out the important part played by voluntary effort preceding the consolidation by law. For example, individual employers have done a considerable amount of experimental work in industrial health, and much of what is known as industrial welfare has proved so valuable that it has now ceased to be voluntary and is to become an obligation. The voluntary activity of progressive employers, aided by the trade unions, has provided the necessary data to form a basis of the new industrial law.

THE Act as it is pegs industrial health and welfare at a higher level than ever before, but it should not be assumed that nothing remains to be done. The long fight to obtain recognition of society's duty to its members is all but won; the next task will be more laborious, and it will lack the spectacular victories of the earlier political struggles. Nor must it be thought that the responsibilities of the employer are ended when he has fulfilled the letter of the law. Many of the wider issues of industrial health, such as the psychoneuroses and emotional disturbance, with their physical sequelæ, arise not out of unhealthy conditions as commonly understood; but out of methods of work, methods of selection of staff, systems of supervision, payment and incentives, and Dr. Lockhart suggests that some form of statutory advisory board might be desirable, since it would be free to raise and discuss these matters before they became political questions. He also advocates an industrial training for doctors as a post-graduate course. The paper raises many important issues, and is worthy of very careful consideration.

Control of Public Lighting

ON December 10, Mr. J. M. Kennedy, Electricity Commissioner, inaugurated the 'Actadis' system for the ripple control of the public lighting of Maidstone. This is the latest development of a method which

began with the lamplighter going his rounds with his pole. The method is the distribution of high-frequency A.C. ripples over the electric supply network from a central transmitting apparatus. The high-frequency machine which generates the current injected at various points into the network is rated at 30 kilowatts, and its frequency can be varied between 300 and 900. They are injected directly on to the 6,600 volt A.C. system and actuate relays on the low-tension side. As condensers are placed in the high-frequency circuits, the power consumption is small. At present there are about 500 relays installed for the control of the lamps. The great advantage of the system is that the whole street lighting of a city can be switched on or off by actuating push buttons at a central point. If this system were adopted in a city, every street lamp could be extinguished within a few seconds of warning of an emergency being received. The system can also be used to control part of a load, for example the load required for the 'water heaters', for a short time so as to prevent the maximum load, as shown by the 'maximum indicator' being exceeded. The system was installed in Maidstone by Actadis Ltd., Vincent House, Vincent Square, S.W.1. The bulk of the apparatus is manufactured in Great Britain.

Coloured Roads

In *Roads and Road Construction* of October 1 Mr. C. W. Manlove considers the question of whether it would not sometimes be advisable, instead of having a mass of signs at the side of the road, to colour the traffic lanes with various colours. A good driver looks at the road surface ahead, and should not be distracted by having to decipher road signs, a necessity which is sometimes contributory to accidents. If the road surface had a tinted colour when the speed limit changed, the driver would automatically notice that he was entering or leaving a controlled area. The coloured road has for several years been a common feature in the United States. This is probably due to the fact that in America many of the roads are made of concrete; in Great Britain concrete roads are only beginning to be made. Recent official tests on the main Bath Road prove that a concrete road has a very long life. It has been computed that if the load does not exceed 15,000 tons of traffic a day, to wear the surface down one inch would take 200 years. The Cement Marketing Board estimates that the cost of tinting the top of a cement carriage road to the depth of two inches, supposing the road to be 30 feet broad, would be about £250 per mile. As international colours are used for colouring electrical engineering diagrams, the day may come when international colours will be used on the surfaces of the roads for warning and directing chauffeurs when danger is ahead and a change of speed is necessary.

The Cross-Channel Ferry Service

THE cross-channel ferry service between Dover and Dunkerque has now been in operation since October 1936. The three ferry steamers engaged in the service carry passengers between Great Britain and

Europe in through sleeping cars. Recently a special ramp has been built which enables motorists to drive straight into the special garage on board the ship, which has accommodation for twenty-five cars. It is not necessary to empty the petrol tanks of the cars before boarding the ship as special fireproof construction has been adopted. The new ramp is a reinforced concrete structure at the side of the ferry dock and there is a portcullis type of transfer bridge which is lowered on to the deck of the ship. The length of each of the ferry steamers is 360 feet and the beam is 63 feet. It is provided with twin screws each driven by a Parsons steam turbine through single reduction gearing. The normal speed is 16½ knots and the total horse-power is 4,900. It takes 500 passengers, 12 sleeping cars (or forty goods wagons) and 25 cars in the garage. The *British Engineers' Export Journal* of August states that the traffic carried by the train ferry is very varied. To the engineering exporter this ferry service is of great value, since heavy and awkward pieces of machinery can be loaded on a truck at Victoria and need suffer no transshipment until they arrive at a destination on the Continent. Up to May 31 of this year, the ferry service conveyed 9,577 loaded wagons, and during the same period 12,277 tons of merchandise were conveyed in through trucks from Dover to Dunkerque, and 23,288 tons were carried in the reverse direction.

Forestry Research in Malaya

THE Research Institute of the Forestry Department of the Federated Malay States has now been in existence for some years and is carrying out investigations of varying types which should have considerable importance for the improvement of the forests of the country. The Institute is organized on the lines of the Imperial Forest Institute at Dehra Dun in India, the branches consisting of silviculture, botanical, wood technology, timber mechanics, seasoning, preservation and durability of timbers and entomology. Chemical investigations affecting forestry are undertaken by the Chemical Division of the Department of Agriculture, a grant being made by the Forest Department for this purpose. The Institute works in collaboration with Princes Risborough and also with the Malayan Railway Department and with the Civil Engineer, H.M. Naval Base, Singapore. The Forest Botanist, whilst on leave, spent some time working on a collection of Malayan specimens at Kew, where, by the courtesy of the director, he was accorded assistance by the Kew Herbarium staff. An item of botanical interest is mentioned in the annual report for 1936 (Forest Research Institute, Kepong, 1936) referring to the Gunong Tahan Expedition. The collection made includes 144 numbers, mainly from the open *padang* of the mountain tops. Although this collection has not yet been completely worked through, it is said that "it is evident that, though it contains very little that is new, it includes some nice material of rare species known only from this locality, e.g. *Agathis flavescens*, Ridl. and *Gentiana malayana*, Ridl."

Forest Bibliography

Two parts of the "Forest Bibliography to 1933" have now been issued from the Department of Forestry of the University of Oxford. This work has been compiled by Prof. R. S. Troup and his staff. The systematic referencing of current forest literature was commenced at Oxford in 1920, and continued jointly by the Forestry Department and the Imperial Forestry Institute after 1924. The object at first was to provide staff and students with facilities for keeping in touch with forestry literature. Recently, in response to requests, publication was decided upon. The Bibliography comprises literature published to the end of 1933, and contained in the library of the Oxford Department of Forestry. Forest literature published on and after January 1, 1934, is being dealt with under the decimal system of classification prepared by Dr. Flury and recently adopted by the International Union of Forest Research Organizations. The Oxford Bibliography is said to comprise a fairly complete list of material published in English and a considerable amount of literature published in French and German. Material from other countries is mainly confined to literature where an English, French or German summary is appended. The first part opens with a list of abbreviated titles and then gives the subjects of classification as *A*, General Forestry; *B*, Sylviculture; *C*, Forest Protection; *D*, Forest Utilization; *E*, Forest Mensuration; *F*, Forest Valuation and Finance; *G*, Forest Management; *H*, Forest Policy and Economics; *I*, Meteorology; *J*, Geology; *K*, Education and Research; *L*, Terminology and Classification of Information; *M*, Engineering and Surveying; *N*, Botany; *O*, Invertebrate Zoology; *P*, Biography. Most of these branches are divided into sub-heads.

The Strangeways Research Laboratory

THE investigations described in the report of the Strangeways Research Laboratory, Cambridge, for 1936 fall into two main divisions: one is concerned with the growth and development of cells and tissues, or with their organization in the embryo; the other deals with the action of radiations on the living cell, with the object of analysing their destructive effect so that the different forms can be used to the best advantage in the treatment of cancer. The methods of cell culture have found many applications in the work of biological and medical laboratories. The Strangeways Laboratory continues to attract workers from other centres, who go to Cambridge to obtain instruction and practice in a difficult and still relatively unfamiliar technique. The Trustees point out that the income of the laboratory is chiefly made up of grants from public bodies and corporations and donations from individuals, which cannot be regarded as permanent. The great need is an endowment to provide an income not necessarily large but assured, so that plans may be laid for the future in reasonable security. Additional space is required for the visitors to the laboratory and for the development of the work on experimental embryology, which has now reached a stage when expert assistance from biochemists is urgently needed. The Trustees express

the hope that a capital sum sufficient to provide an extension to the present building may be forthcoming, as well as sufficient funds to provide the requisite additional annual income.

Training in Business Administration

ESTABLISHED seven years ago, the Department of Business Administration at the London School of Economics provides a post-graduate course extending normally over one year for men and women who intend to follow a business career. It has been found that such post-graduate students are of three main types. First, there are university graduates in economics, commerce or Modern Greats who require chiefly to learn the practical application of principles of which they are already familiar. Secondly, there are graduates in modern languages and technical subjects such as chemistry and engineering who already have technical qualifications which would often enable them to obtain immediate employment without difficulty. Later on, however, as they rise to positions of responsibility, they may find themselves obliged to exercise functions of management for which their technical training by itself provides little preparation. Training in business management should enable them to avoid many of the initial mistakes inevitable in a process of learning by trial and error. Thirdly, there are students who have already had considerable experience of business and who come or are sent by their employers to widen their outlook and increase their capabilities. At first sight it would seem difficult, if not impossible, to frame a course which would be equally suitable for these different groups, with their varying types of training and background. Experience has shown, however, that given appropriate methods of teaching, the lack of homogeneity in the class is a source of strength rather than of weakness. The work is carried on mainly in a series of discussion classes, to which each student can contribute from his own special knowledge.

Memorial to the late Viscount Grey of Fallodon

THE report of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, presented at the annual meeting on October 26, states that the North Country Memorial takes the form of a simple inscription engraved upon the masonry of the Hancock Museum in Newcastle, near the entrance. An essential part of the memorial was the creation of an endowment fund which would help to ensure the continuance of the Museum itself, and this Memorial Endowment Fund now amounts to £8,156. The sum is none too large for its purpose, but the fund is still open, and it is hoped that further donations will be received. The summary of accounts which is included in the report shows that the payments for the past year exceeded the receipts by £52 19s. 10d. The Museum itself is a valuable educational institution, and while the number of ordinary visitors is slightly down at 12,348, the increasing use made of the exhibits by classes of pupils from Newcastle Council Schools is encouraging. During the year, 1,337 scholars visited the Museum with their teachers, and arrangements have been

made whereby pupils of the schools under the Northumberland County Education Committee may share in the advantages hitherto restricted to town children.

Garden Plants from China

AN interesting account of the botanical pioneers who first made known the wonderful flora of China, appears in the *Journal of the Royal Horticultural Society* (62, Pt. 8, 347-351, August 1937). It is mainly a review of a "History of European Botanical Discoveries in China" by E. Bretschneider. The volume is one of the treasures of the Society's Lindley Library, and the article is from the pen of Mr. F. C. Stern. It was not until nearly 400 years after Marco Polo's celebrated journey that Europeans took an interest in the decorative plants of China. Domenico Parenin first mentioned *Wistaria chinensis* in 1698, but Father Pierre d'Incarville was probably the first botanical collector in China, about half a century later. It was not until the early part of last century, however, that Chinese plants began to find their way into European gardens; previous collections had been for herbarium material. The work of Dr. Abel, John Reeves, Robert Fortune, Dr. Hance, Father Armand David, Father Jean Marie Delavay, Nicolai Przewalski, Dr. Augustine Henry and other investigators of last century, is described. The account of their collections makes interesting reading, and the plants they introduced are among the greatest contributors to garden beauty.

Tokyo Earthquakes of 1936

THE last *Seismometric Report* issued by the Earthquake Research Institute completes the list of earthquakes felt in Tokyo in 1936. In addition to the central station, there are eleven others at various distances up to eighty-four miles from Tokyo, and the records obtained at these stations have enabled the position of the epicentre in all the earthquakes, and the focal depth in all but three, to be determined. The year 1936 is notable on two accounts. It is the year of fewest earthquakes in the district since the network of stations was formed, the number being only 31, or less than half the average number (64) in the preceding twelve years. Also, more than half the centres were submarine, 14 lying beneath the Pacific Ocean, 4 below Tokyo Bay, and only 13 under land. The depth of focus ranges from 15 km. to 80 km., the average being 45 km. None of the earthquakes was of destructive strength, but in one—that of November 3—the shock was of degree 7 of the Rossi-Forel scale or strong enough to throw down ornaments, vases, etc. Indeed, only four of the 797 earthquakes in the thirteen years were strong enough to cause slight damage to buildings.

The Rubber Research Institute, Malaya

THE year 1937 will stand out in the history of the Rubber Research Institute, Malaya, as it marks the beginning of a second decade of activity and was the occasion of the occupation of new premises. The purpose and recent work of the Institute are well

described in an illustrated booklet and the annual report for 1936, both of which have recently been published (Kuala Lumpur: The Institute). Research work is carried out in four main divisions, botanical, pathological, chemical and soils respectively. Many of the investigations are necessarily made in the field, both at the Institute's Experimental Station and also on, and in co-operation with, a large number of estates throughout Malaya. Retrenchment of staff during the slump and a disastrous fire in 1936 seriously curtailed the activities of the Institute, but a period of expansion is now coming into being, and the rapid development of the advisory work is good evidence that this service is appreciated by estate owners and small-holders alike.

Deep Well Drilling

At the Rumanian Branch of the Institution of Petroleum Technologists, on November 27, a discussion was held on problems of deep well drilling. (*J. Inst. Pet. Tech.*, 23; 1937). Mr. G. Elias opened by summarizing the points he considered most influential in successful drilling to depth. Accidents must be avoided at all costs, and the only way to safeguard against them is by provision of suitable equipment, drillers and crews. Mud conditions must be good, as they are invariably reflected in the condition of the well itself. The ultimate cost of the well and drilling time are largely dependent on the selection of a suitable casing programme, and this should be drawn up in new areas immediately the necessary information is available from first wells. An adequate steam supply should be available on the site, not only to reduce the time factor, but also to ensure that a big volume of mud is circulated. Particular care should be taken to see that adequate derricks are employed and also that their foundations are such as to prohibit uneven settling.

Maternal Mortality

THE Ministry of Health has issued two reports upon this subject, namely, (a) "An Investigation into Maternal Mortality in England", and (b) "Maternal Mortality in Wales" (London: H.M. Stationery Office. 5s. 6d., and 2s. 6d., respectively). The national average for maternal mortality has remained for a number of years in the neighbourhood of 4 mothers per 1,000 live births, despite great expansions in maternity services and remarkable improvement in the general health of the community. The provisional figures for 1936 show a slight decline, the rate for that year being less than 4. In many districts in England and in Wales, however, the maternal mortality rate is higher than the average, being 5 or more, and the two reports survey the circumstances that may be responsible for this excessive mortality in England and Wales, and the measures that may be taken to reduce it. The rate is generally higher in industrial areas and lower in rural ones. The first report deals more fully with prevention, and a section is devoted to the subject of abortion. Attempted abortions appear to be frequent and on the increase, as well as to be responsible for a number of deaths from puerperal sepsis.

Safe Catgut for Surgical Use

REFERENCE has been made on two or three occasions in *NATURE* to the risk of tetanus arising from the use of imperfectly sterilized catgut for surgical ligatures. In order still further to reduce the risk of tetanus infection, the Minister of Health has issued new regulations which require all surgical ligatures and sutures, including catgut, that are not sold under the special licensing arrangements of the Therapeutic Substances Act, to bear a label stating in prescribed terms that efficient sterilization is necessary before use (Statutory Rules and Orders, 1937, No. 767, and Circular 1641. H.M. Stationery Office. *Id.*). Catgut which is sold under licence under the Therapeutic Substances Act is free from any possible risk of infection, as its manufacture is strictly controlled and it is properly sterilized before being put on sale.

Bird Protection in Britain

DISSATISFACTION has often been expressed with the legislation by which birds are protected in Great Britain, although there can be little doubt that the law has had the effect of increasing the number of some desirable birds and of extending the survival period of others which were becoming too scarce. The present code of bird protection laws is, however, too complicated and cumbersome, and in several respects it lacks provisions which would much increase its efficiency, so that time and again attempts have been made to consolidate the position. For those who are interested in the present position, particularly in view of the possibility of future legislation, a brief but informative summary of the Acts under which birds are protected in Great Britain has been written by the editor of *Bird Notes and News*, and a first instalment appears in the autumn number (vol. 17, 167; 1937).

Bronze Bust of Sir Arthur Keith

It is proposed to present Sir Arthur Keith with an excellent bronze bust of himself in appreciation of his work in the fields of anatomy, embryology and anthropology. Sir Arthur wishes to hand over the bust to the keeping of the Royal College of Surgeons, should it be found possible to secure it. The sum of £150 is required to purchase the bust, and contributions are invited towards this amount. Cheques should be made payable, and be sent, to the secretary of the Royal College of Surgeons, Lincoln's Inn Fields, London, W.C.2 ("Arthur Keith Bust Fund"). Sir Arthur Keith has been invited by the College to give a lecture on the ancient types of man which were discovered in Palestine some years ago. This lecture will be given in the College Theatre on February 14, 1938, and it is proposed to present him with the bust on that occasion.

Announcements

THE following awards have recently been made by the Royal Aeronautical Society: *Simms Gold Medal*: to Dr. N. A. de Bruyne for his paper on "Plastic

Materials for Aircraft Construction"; *Taylor Gold Medal*: to G. Mead, for his paper on "Power Plant Trends"; *Wakefield Gold Medal*: to Dr. G. V. Lachman, for his paper on "Aerodynamic and Structural Features of Tapered Wings"; *Edward Busk Memorial Prize*: divided between Major B. C. Carter, for his paper on "Airscrew Blade Vibration", and A. G. Pugsley, for his paper on "Control Surface and Wing Stability Problems"; *Pilcher Memorial Prizes*: to A. J. Hanson, for his paper on "Critical Speeds of Monoplanes", and C. O. Vernon, for his paper on "Aircraft Performance Estimation".

At the ordinary meeting of the Institution of Electrical Engineers held on December 16, an oil painting of Mr. Sydney Evershed, by George Harcourt, R.A., was presented to the Institution. The painting was subscribed for by the many business associates and admirers of Mr. Evershed, to commemorate the fiftieth anniversary of his entry into the electrical industry, and it was formally presented, on their behalf, by Lieut.-Col. W. A. Vignoles.

At the annual general meeting of the London Mathematical Society on November 18, the following were elected officers and council for the session 1937-38: *President*: Prof. E. A. Milne; *Vice-Presidents*: Prof. G. B. Jeffery, Miss M. L. Cartwright, Mr. J. Hodgkinson; *Treasurer*: Dr. A. E. Western; *Librarian*: Prof. H. Hilton; *Editor*: Prof. G. N. Watson; *Secretaries*: Mr. F. P. White, Mr. W. L. Ferrar. At the December meeting, the Council received with great regret the resignation of Mr. W. L. Ferrar from the office of secretary, as from January 1, 1938; Mr. P. Hall, King's College, Cambridge, has been appointed to succeed him.

THE twenty-sixth annual Conference of Educational Associations will be held in University College, London, on January 3-10 under the presidency of the Right Hon. Sir Kingsley Wood, M.P. On January 4, Sir Kingsley Wood will deliver his presidential address entitled "Education and Health". A joint conference on "Health in the Schools" will be held on January 6. Further information can be obtained from the Conference Secretary, Gordon House, 29 Gordon Square, W.C.1.

THE Carnegie Institution of Washington has issued a catalogue of its publications, either issued or in press, consisting of a numerical list and a classified list arranged under subjects, with brief descriptive notes on the publications listed. A few copies of the publications still in print are reserved for sale at prices quoted, and those out of print can be consulted in certain libraries throughout the world in which they were deposited on publication. A list of these libraries is obtainable on request. Subjects covered by the catalogue include astronomy, botany, chemistry and physics, engineering, genetics, folk-lore, geology, mathematics, nutrition, philology, terrestrial magnetism and zoology.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1102.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Divided Aurora Rays with one Part in the Sunlit and another in the Dark Atmosphere

On October 11 last a fine aurora was photographed from eight of my aurora stations in southern Norway. The stations Kongsberg, Tönte and Askim, forming a triangle with sides 105 km., 80 km. and 85 km., worked together with my station on the eastern roof of the Oslo Observatory; all four were connected



Fig. 1.

DIVIDED AURORA RAYS AT 19h 55m 7s, PHOTOGRAPHED FROM KONGSBERG, BY MR. BUSENGDAL.

by telephone and took simultaneous pictures in continual succession as rapidly as possible. Three other stations, Tuddal, Lillehammer and Oscarsborg, forming a triangle with sides 178 km., 159 km. and 101 km., were in the same manner connected with my other station on the western roof of the same Observatory and worked independently of the first set.

Among the sixty-five successful sets of aurora pictures taken this night there are some of unusual



Fig. 2.

THE SAME RAYS PHOTOGRAPHED AS IN FIG. 1 PHOTOGRAPHED SIMULTANEOUSLY FROM TÖNTE, BY MR. ALBERT TÖNTE.

interest showing high aurora rays divided by a dark space where the rays are penetrating the boundary between sunlit and dark atmosphere. A similar case of this rather infrequent phenomenon, on March 15-16, 1929, has earlier been published in NATURE¹.

In Figs. 1 and 2 are seen two of the four simultaneous pictures taken on October 11, 1937, at

19h 55m 7s G.M.T. from my stations Kongsberg and Tönte, base-line 105 km. Fig. 3 is an explanatory sketch to the Kongsberg picture.

The two other simultaneous pictures from Oslo and Askim show the same features; there can therefore be no doubt that the lower rays are the continuation of the upper ones. Due to the long base-line, the parallaxes are good, about 5°, in spite of the great distance to the rays. In fact they were lying about 1,000 km. away, over a region at 68° latitude and 3°-9° longitude east of Greenwich, to the west of the Lofoten Islands.

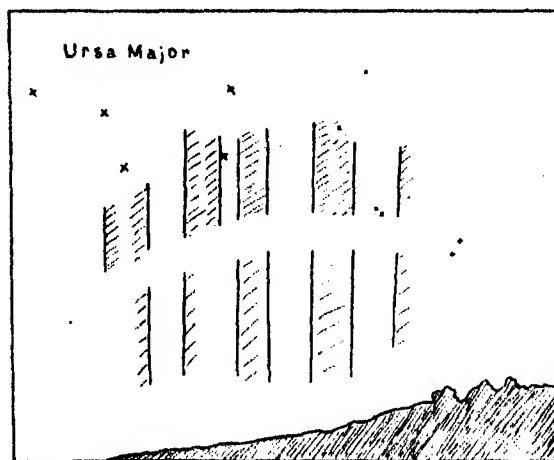


Fig. 3.

SKETCH OF THE KONGSBERG PICTURE.

The upper rays, which had a rather red tint compared with the lower ones, had their base points 415-480 km. above the earth, and their summits reached to about 625 km. These rays were situated in full sunshine. The continuation of the rays downwards went from about 350-400 km. down towards the horizon, where they can be followed to about 175 km. above the earth. They were all in shadow.

What is most remarkable, however, is the dark space between the upper and lower parts of the rays, comprising the boundary between sunlit and dark atmosphere. It seems as if the light of the rays is extinguished in the vicinity of this boundary and recovers again lower down.

This phenomenon is rather infrequent, and lasted only a few minutes. On a picture taken one minute later, the lower parts are much weaker. This last picture gives, however, a valuable check on the height measurements. In fact, by a pure chance, the rays happened to be photographed by all eight stations almost at the same time, and a calculation with the formidable base-line Tuddal-Lillehammer of

178 km. gave very nearly the same height as the calculation with base Kongsberg-Tönte, namely, a height of 410–450 km. for the base points of the sunlit parts of the rays.

The last traces of sunlit aurora rays were photographed at 20^h 14^m G.M.T., four hours after sunset in Oslo. These were lying about 400 km. south-west of their former position and their base points were also near the earth's shadow, more than 400 km. above the earth. The lower parts did not appear this time.

A spectrum was taken of these sunlit rays on a panchromatic plate Agfa ISS. The plate was first exposed from 19^h 55^m to 19^h 58^m on the rays just under β and γ Ursae majoris, and then from 19^h 58^m to 20^h 15^m on similar rays to the left of η and ξ of the same constellation. In this spectrum the line 6300 Å. is by far the strongest; next come the lines 5577 Å., 6550 Å., as in the spectrum obtained on October 16 last year².

These phenomena of sunlit aurora rays are very remarkable and their closer study may throw new light on the physical state of the upper atmosphere. It would be of interest to do experiments on the possible action of light, in particular ultra-violet, on the light phenomena of corpuscular rays in rarified gases, to solve the problems which these sunlit aurora rays present to us.

CARL STÖRMER.

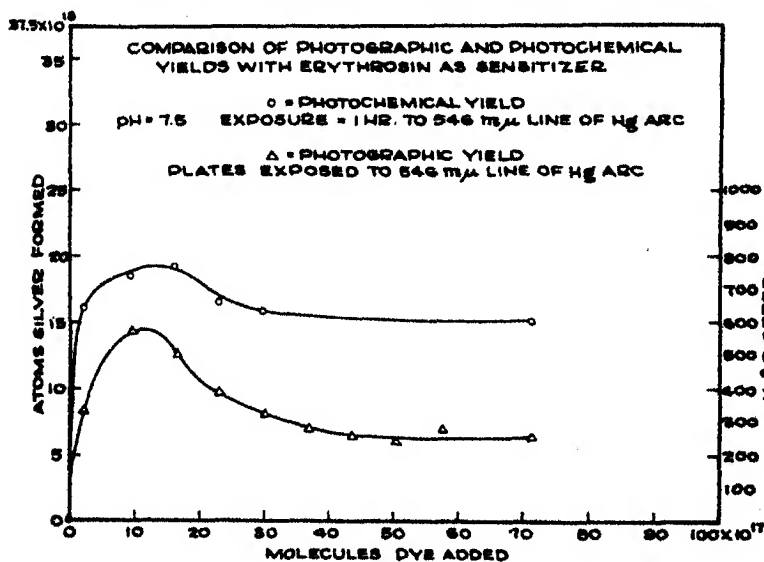
Institute of Theoretical Astrophysics,
University, Blindern,
V. Aker, Norway.

¹ Störmer, C., "New Evidence of the Action of Sunlight on Aurora Rays", NATURE, June 8, 1929.

² NATURE, 139, 584 (April 8, 1937)

Mechanism of Optical Sensitizing of Silver Halides by Dyes

It has not been definitely settled whether optical sensitizing involves a chemical decomposition of the dye. The observation of Lescynski¹ that some twenty



atoms of silver could be obtained (for a certain exposure) for one dye molecule indicated that either a 'physical' transfer of energy is effected, or else a chain reaction, with regeneration of the dye molecule.

Bokinik and Iljina² have published results to somewhat the same effect as those of Lescynski. Working with silver bromide sols sensitized with erythrosin, they found a continued linear growth of silver atoms with number of erythrosin molecules added to the sol, and, according to the exposure, yields of four to fifteen atoms of silver per molecule of dye.

In repeating and extending the procedures of Lescynski and of Bokinik, we have obtained results which, while in agreement on some points, diverge widely on others. In our first experiments with a simple silver halide hydrosol (stabilized with slight bromide ion excess and sensitized with erythrosin) the dye was found to be destroyed progressively with exposure to light, and the number of silver atoms formed was between one and two per dye molecule disappearing. This was obtained in approximately monochromatic light 5460 Å., cutting out the blue-violet light. However, check observations showed that the dye also disappeared on exposure to the blue-violet light absorbed by silver bromide, eliminating the green light absorbed by the erythrosin-silver halide complex. This could only be due to the photolytically produced bromine attacking the dye. On repeating the experiments in green light (5460 Å.) with the blue-violet excluded, but with adequate halogen acceptors present (acetone semi-carbazide, phenol) the result obtained was: The adsorbed dye was not destroyed by the light absorbed, but bromide ions were converted to bromine, silver ions to metallic silver, progressively with exposure. (The reaction, at first linear with time, slows down as the surface is exhausted.)

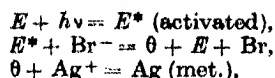
In the case of erythrosin, the evidence is that by no means all the dye molecules adsorbed are active photolytically. The amount of silver produced by a given exposure increases rapidly at first, with increase of adsorbed dye, but reaches a limit long before adsorption saturation. In the case of basic (polymethine) dyes, the limit of the photolytic yield may

coincide approximately with adsorption saturation. A photochemical equivalent (silver atoms formed per quantum absorbed) of about 0.3 was found in the case of erythrosin. The photographic efficiency of erythrosin, in terms of photographic sensitivity as a function of dye adsorbed, closely parallels the photolytic yield, as shown in the accompanying curves.

While our results confirm those of Lescynski, and of Bokinik and Iljina, in demonstrating that a single molecule of adsorbed dye can give rise to a large number of silver atoms (depending upon exposure, etc.) they differ widely from those of the latter authors in the observation of an early limit to the photochemical yield as a function of degree of adsorption. These authors make no mention of the addition of a halogen acceptor; in the absence

thereof we get no such yields of silver atoms, and find the dye to be destroyed. Our principal result is that the optically sensitizing dye facilitates the transfer of an electron from a bromide ion to a silver ion, without undergoing decomposition itself. Formally,

this might be expressed as



the quantum $h\nu$ being absorbed by the erythrosin adsorbed to the silver halide, and being much smaller than that required to effect the transfer directly.

A fuller discussion of this process together with details of the experimental and analytical procedures will be published elsewhere.

Research Laboratories,
Eastman Kodak Company.
Rochester, N.Y.
Nov. 5.

S. E. SHEPPARD.
R. H. LAMBERT.
R. D. WALKER.

¹ Leszynski, W., *Z. wiss. Phot.*, **24**, 261 (1926-27).

² Bokimk, J. I., and Iljina, Z. A., *Acta physicochimica, U.R.S.S.*, **3**, 383 (1935).

Cozymase in Invertebrate Muscle

RECENT work from the institutes of Meyerhof¹ and von Euler² has demonstrated the important part played by cozymase in muscle glycolysis. Cozymase has now been quantitatively determined in, and isolated in a pure form from, mammalian muscle³. In muscle, as in other tissues, cozymase is present partly in the reduced, dihydro form in equilibrium with the oxidized form, 35-40 per cent of the total cozymase in mammalian muscle being in the reduced form^{3,4}.

An interesting feature in the physiology of cozymase is its rapid inactivation by tissue enzymes after the death of the organism⁴. Its distribution in living tissues has been reviewed by von Euler⁵.

We have now determined the cozymase in the fresh musculature of marine invertebrates from various phyla as well as its autolytic inactivation by the minced tissue. The technique has been described elsewhere^{6,7}. As standard, highly purified cozymase, kindly supplied by Dr. P. Ohlmeyer, has been used. The accompanying table summarizes the results.

COZYMASE IN FRESH MUSCLE (mgm. per gm.).

Phylum	Species	Muscle	Structure	Oxidized form	Reduced form	Oxidized + reduced forms	Per cent reduced form
Coelenterata	<i>Metridium senile</i>	Dermomuscular coat	Mixed	0.022	0.008	0.030	27
Gephyrea	<i>Phascolosoma vulgare</i>	Retractors of proboscis	Smooth	—	—	0.174	—
Arthropoda	<i>Homarus vulgaris</i>	Tail	Striated	0.280	0.170	0.450	38
Mollusca	<i>Pecten maximus</i>	Adductor	Striated	0.140	0.099	0.239	41
"	<i>Ostrea edulis</i>	Adductor	Smooth	0.187	0.134	0.321	42
"	<i>Buccinum undatum</i>	Columnellar	Smooth	0.132	0.069	0.201	34
"	<i>Sepia officinalis</i>	Mantle	Smooth	0.220	0.170	0.390	44
Echinodermata	<i>Echinus aculeatus</i>	Jaw	Striated	0.073	0.058	0.131	45
"	<i>Holothuria nigra</i>	Longitudinal bands	Smooth	0.026	0.008	0.034	23

Although its concentration varies widely, cozymase is present in all the muscles examined. In the powerful striated tail musculature of *Homarus* and in the smooth mantle muscle of *Sepia*, its concentration is as high as in mammalian muscle³. Not much difference in concentration is found between striated and smooth muscles. This is particularly exemplified in the adductors of *Pecten* and *Ostrea*. The smallest concentrations are found in the coelenterate *Metridium* and in the two representatives of the echinoderms examined. The higher concentrations are thus shown

by those muscles capable of swift or sustained vigorous activity.

In *Metridium*, *Echinus* and *Holothuria* the pyrophosphate P is also lowest, ranging from a trace to 0.2 mgm. P₂O₅ per gm. fresh muscle as against 0.5-1.0 in the other groups.

It seems interesting that the ratio of the oxidized to the reduced form is fairly uniform and within the limits of that in mammalian musculature. The amount of enzymic inactivation during 4 hours autolysis at 18° has also been found to be fairly uniform, ranging from 30 to 50 per cent of the cozymase originally present. This is definitely lower than in mammalian musculature, where it ranges from 80 to 95 per cent^{3,4}.

This work has been done while one of us (S. O.) was holding a Ray Lankester investigatorship.

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Nov. 26.

- ¹ Meyerhof, O., and Ohlmeyer, P., *Biochem. Z.*, **290**, 334 (1937).
² v. Euler, H., Adler, E., Günther, G., and Hellström, H., *Z. physiol. Chem.*, **245**, 217 (1937).
³ Ochoa, S., *Biochem. Z.*, **292**, 68 (1937).
⁴ v. Euler, H., and Helwink, H., *Naturwissenschaften*, **25**, 209 (1937).
⁵ v. Euler, H., *Ergeb. d. Physiol.*, **58**, 1 (1936).
⁶ Ohlmeyer, P., *Biochem. Z.*, **287**, 212 (1936).
⁷ Ohlmeyer, P., and Ochoa, S., *Biochem. Z.*, **293**, 338 (1937).

A New Oxidation Catalyst

COENZYMES I and II occupy pivotal positions in biological oxidations. The great majority of metabolites in animal tissues are oxidized through the intermediation of these coenzymes. But whereas the mechanism of the reduction of the coenzymes by dehydrogenase systems is well understood, the physiological mechanism of the oxidation of reduced coenzyme I or II has been obscure.

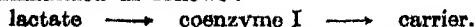
The reduced form of coenzyme I is oxidized extremely slowly by methylene blue, flavin, cytochrome c, etc. If a phosphate extract of washed and ground muscle tissue is added to a mixture of reduced coenzyme and one of these carriers, the rate of

oxidation of reduced coenzyme is increased some twenty-fold. We have fractionated this extract by centrifugation and have found that the insoluble sediment con-

tains the factor which catalyses the oxidation of reduced coenzyme I. The insoluble particles with which the factor is associated can be washed exhaustively by repeated suspension in water and centrifugation without any loss in activity. The factor is destroyed by exposure to 52° for 15 min., by precipitation with acetone or by drying.

The lactic dehydrogenase system as prepared by Green and Brosteaux¹ rapidly catalyses the oxidation of lactate by means of flavin, methylene blue and

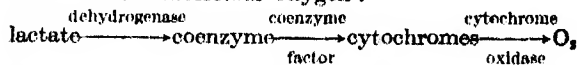
other carriers. The stages in these oxidations may be summarized as follows:



The arrows indicate the direction of transfer of hydrogen. The dehydrogenase is involved only in catalysing the oxidation of lactate by the coenzyme. The fact that the overall reaction is very rapid must therefore mean that the oxidation of reduced coenzyme by the carrier is not the slow spontaneous process referred to above, but that it is definitely catalysed. The lactic dehydrogenase preparation can be resolved by various methods into a water-clear solution containing the dehydrogenase and a suspension of insoluble particles containing the coenzyme factor. Neither solution alone can catalyse the oxidation of lactate by methylene blue whereas both together rapidly do so. This resolution of the two catalytic components has been accomplished with practically every coenzyme dehydrogenase system known in animal tissues; for example, lactic, malic, β -hydroxybutyric, alcohol, hexosemonophosphate, triosephosphate and triose.

Thus for the oxidation of metabolites, in coenzyme systems at least two catalytic agents are required; (1) the soluble dehydrogenases which catalyse the oxidation of the substrate by the coenzyme and (2) the insoluble coenzyme factor which catalyses the oxidation of reduced coenzyme by the carrier.

The studies of Keilin have demonstrated that the oxidation of practically all metabolites directly or indirectly proceeds via the cytochromes. Hitherto, no satisfactory link has been found between coenzyme systems on one hand and the cytochrome system on the other. Recently Dewan and Green described a coenzyme oxidase in animal tissues which catalysed the oxidation of reduced coenzyme by molecular oxygen¹. We have succeeded in resolving the so-called coenzyme oxidase into three insoluble components, (1) the coenzyme factor, (2) cytochromes *a* and *b* and (3) cytochrome oxidase. What we considered to be a direct oxidation of reduced coenzyme by molecular oxygen is really a two-stage process, namely, oxidation of reduced coenzyme by one of the cytochrome components (probably *a*)² and oxidation of reduced cytochrome by molecular oxygen. The coenzyme factor catalyses the first oxidation, and the cytochrome oxidase catalyses the final reaction with molecular oxygen:



Since the cytochrome oxidase is poisoned by cyanide, the overall reaction does not take place in presence of dilute cyanide.

The coenzyme factor is not identical with flavoprotein or any known carrier. Strictly speaking, the coenzyme factor is a dehydrogenase which specifically catalyses the oxidation of reduced coenzyme by carriers. It is interesting to note that whereas flavoprotein, like the coenzyme factor, catalyses the oxidation of reduced coenzyme by carriers in pure solutions, it shows practically no activity as factor in any of the animal coenzyme I dehydrogenase systems we have studied. This paradox is difficult to explain.

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¹ Green and Brousteaux, *Biochem. J.*, **30**, 1489 (1936).

² Dewan and Green, *Biochem. J.*, **30**, 1069 (1937).

³ We are indebted to Professor D. Keilin for this information.

Influence of Hydrogen and Water Vapour upon the Combustion of Carbon Monoxide Mixtures

It is well known that the addition of hydrogen and water vapour to inflammable carbon monoxide mixtures speeds up the rate of flame travel. Experiments now in progress show that the flame temperatures determined by platinum thermometry also are increased.

The influence of hydrogen will be clear from an examination of Table I, in which are given the flame temperatures developed after the combustion of the mixtures (25 - *x*) per cent CO + *x* per cent H₂ + 75 per cent air when *x* is increased from 0 to 5.

TABLE I.

Percentage hydrogen	Flame temperature (° C.)	Latent energy (per cent)
0	1650	20.5
1	1705	17.5
2	1725	16.5
3	1735	15.5
4	1745	15.0
5	1750	14.5

It will be seen that there is a marked increase in flame temperature when hydrogen replaces a little of the carbon monoxide. A 1 per cent replacement increases the flame temperature by 55° C. A 5 per cent replacement increases the flame temperature by 100° C., in spite of the fact that there is a decrease of 25° C. in the ideal calculated flame temperature.

In a previous letter¹, it was stated that an addition of about 2 per cent water vapour to a carbon monoxide - air mixture had very little influence upon the flame temperature attained, but since the water vapour was added to the mixture the quantity of combustible gas was reduced. When the proportion of combustible gas is kept constant, and water vapour is added at the expense of the air alone, the flame temperature increases substantially. This may be seen from Table II, in which are given the flame temperatures after the combustion of the mixtures, 25 per cent CO + *y* per cent H₂O + (75 - *y*) per cent air, where *y* is increased from 0 to 2.14.

TABLE II.

Water vapour (per cent)	Flame temperature (° C.)	Latent energy (per cent)
0	1650	20.5
0.87	1675	19.5
1.50	1690	18.5
2.14	1700	17.5

In all the experiments, combustion took place at atmospheric pressure.

The latent energy, which is expressed as a percentage of the heat of combustion in the tables, resides, we believe, in the long-lived metastable molecules formed in the flame front. Small quantities of hydrogen and water vapour would appear to reduce the number of the metastable molecules formed during the combustion of dry carbon monoxide mixtures.

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Nov. 26.

¹ NATURE, **139**, 289 (Feb. 13, 1937).

Sound-Films as Diffraction Gratings for the Visual Fourier Analysis of Sound-Waves

It may be of interest to give a preliminary account of what I believe to be a new method of producing acoustic spectra. The method, which is to employ the striations on "variable-density" sound-film as a diffraction grating for monochromatic light, permits an instantaneous separation of sound into its components which is analogous to the directness with which a spectroscope analyses light. If sound-film is modulated by a pure tone, a visual appreciation of frequency is clearly possible, the diffraction angle increasing with frequency. It might be anticipated that in the case where numerous frequencies are present, the diffraction pattern might contain a confused series of combination frequencies, after the manner of the 'ghosts' which appear with imperfect diffraction gratings possessing extraneous periodicities. A further complication might be expected from the fact that the range of frequencies recorded on the film extends over at least seven octaves, producing a correspondingly great overlapping of orders of spectra.

Theoretical investigation, however, reveals a very interesting state of affairs, which is briefly outlined below. Some of the conclusions are not new, but they are re-expressed because of their present application, and because they represent a departure from the traditional view of optical gratings.

(a) The Fraunhofer diffraction effect achieves as a physical process the same integrations that furnish the amplitudes and phases of the terms of a Fourier series. The function which the series represents is the variation of the light-amplitude on traversing the grating, which may be called for brevity its transparency curve.

(b) The customary orders of spectra of an optical grating represent the harmonics present due to the abrupt discontinuities in the transparency curve.

(c) A sound-film with a purely sinusoidal variation in the amplitude of the light transmitted will give rise to a first-order diffracted beam only; a film with any number of such periodicities superposed will give one diffracted beam for each component and no others.

There is thus no question of orders overlapping, and furthermore, if ghosts appear, they are merely a proper indication that a component of one frequency has been modulated by another frequency, the ghosts arising in the same way as the upper and lower sidebands which occur in wireless. One of the possibilities suggested by the theory is the analysis of transient sounds. Taking as the simplest case a pure tone of short duration, the record on the film acts as a grating of limited resolving power, and the resulting spread of the diffracted beam is just such as corresponds to the frequency range required to form the original 'wave-packet'.

It is necessary to employ for the recording apparatus a light-shutter the response of which is proportional to the square of the amplified audio-frequency current (for example, a shutter operating on the dynamometer principle) in order that the amplitude and not the intensity of the transmitted light may follow the wave-form of the sound pressure.

A simple experiment illustrates the way in which a complex wave-form can be analysed by this method. If interference fringes are formed on a photographic plate with a mercury arc, each actinic wave-length

of the source impresses a different set of sinusoidal bands upon the plate. The developed plate used as a grating with a sodium lamp as source reproduces the lines of the mercury spectrum in yellow light, but in the first order only.

A fuller account of this work will be presented for publication elsewhere.

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Adiabatic and Isothermal Compressibilities of Heavy Water

ABOUT 50 grams of heavy water supplied by the Norsk Hydro-Elektrisk Kvaestofaktieselskab as 99.2 per cent pure ($d_4^{20} = 1.1049$) has been used in the present investigation. The refractive index of the sample has been found to be 1.3278 for the D line at 30° C., which may be compared with 1.3276 given by Luten¹ under the same conditions. Using a piezometer made of soda glass and similar in construction to that employed by Tyrer² and recently by Dakshinamurti³, the adiabatic compressibilities of heavy and ordinary water are determined. Tyrer's value for ordinary water is also given below for comparison. The specific volume, its variation with temperature and the specific heat in each case are taken from the existing literature and used for calculating the isothermal compressibility with the help of the well-known thermodynamical equation. Small variations in these do not appreciably affect the result, and hence the degree of accuracy with which they have been determined is of little consequence.

		Temp.	Spec. vol.	dV/dT	C_p	$\beta_p \times 10^6$	$\beta_T \times 10^6$
Water	Tyrer	30.0	1.00434	0.000304	0.9979	44.5	45.2
	Authors	29.2	1.00434	0.000304	0.9979	45.9	46.6
Heavy water	Authors	29.5	0.9128	0.000277	1.003	42.0	42.6

The compressibility of heavy water is nearly the same as that of ordinary water, and the ratio of the isothermal to the adiabatic compressibility is very close to unity as in the case of water. The above figures also enable us to predict that the intensity of the Rayleigh scattering in heavy water will be of the same order as that in ordinary water.

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Oct. 28.

¹ *Phys. Rev.*, **48**, 161 (1934).

² *J. Chem. Soc.*, **108**, 2534 (1914).

³ *Proc. Ind. Acad. Sci.*, **5**, 385 (1937).

Drift of Net Assimilation Rate in Plants

In a recently published note¹, the effect of age on net assimilation and relative growth-rates in the cotton plant is discussed. Although details² of the experiments have not reached me, it is evident from the note that O. V. S. Heath's results conflict with data already published^{3,4} from this laboratory. In the experiments with cotton, no general rise or fall in the net assimilation rate (dry weight basis) was

found up to the time of flowering and, although it is admitted that the absence of such a drift with time is not proved, Heath claims that his data confirm the findings of Gregory⁴. The latter found the net assimilation rate (area basis) to be independent of time up to maximum leaf area in barley, and he accounts for 80 per cent of the variation of his data in terms of the variation in external factors.

In our own experiments with Sudan grass and oats^{3,4}, there are marked significant falls with time in the net assimilation rate or unit leaf rate (dry weight basis) before flowering. With the tobacco plant, too, unpublished data from this laboratory show very rapid falls in net assimilation rates with time on either dry weight or area bases. That the falls are not solely due to an effect of temperature is clear from the fact that the oats⁴ were grown under conditions of steadily rising mean daily maximum temperatures. With the Sudan grass³ also, temperature was rising during a portion of the period before flowering.

Where the dry weight basis is used, a progressive increase in the fibre content of the leaves would partly account for a fall in the net assimilation rate with age; this points to the inadequacy of the dry weight basis for comparative measurements. It is also possible that the use of leaf area as a basis for the expression of metabolic rates introduces time drifts of a complicated kind.

The data from this laboratory call for further interpretation, and to this end analytical work is already in progress.

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Nov. 8.

¹ Heath, O. V. S., *Ann. Bot.*, N.S., 1, 585 (1937).

² Heath, O. V. S., *J. Agric. Sci.* (in press).

³ Ballard, L. A. T., and Petrie, A. H. K., *Austral. J. Exp. Biol.* 14, 135 (1936).

⁴ Williams, R. F., *Austral. J. Exp. Biol.*, 14, 165 (1936).

⁵ Gregory, F. G., *Ann. Bot.*, 40, 1 (1926).

Series Effect on the Dipole Moments of Some Alkyl Halides

THE problem of induction along hydrocarbon chains has been the subject of some of our previous papers¹ on measurements of dipole moments in solution. The experiments now reported relate to the moments of alkyl bromides and iodides as determined in benzene solution at 20°, and the values may be compared with those determined with the vapours².

Although earlier values of these moments determined in solution have been published³, considerable divergencies exist among the results, and neither of the two series has been completely investigated in solution under the same conditions. The apparatus and the method of calculation used were those previously described⁴. The values of the polarizations and the dipole moments, expressed in Debye units, are given below.

Compound	P_{∞} (c.c.)	P_{∞}^0 (c.c.)	μ
CH ₃ I	61.5	19.3	1.41
C ₂ H ₅ I	90.8	24.2	1.78
n-C ₃ H ₇ I	101.0	28.9	1.84
i-C ₃ H ₇ I	100.5	29.3	1.95
n-C ₄ H ₉ I	105.0	33.5	1.88
n-C ₅ H ₁₁ I	100.7	33.2	1.88
C ₂ H ₅ Br	94.9	19.1	1.89(°)
n-C ₃ H ₇ Br	102.8	23.6	1.93
i-C ₃ H ₇ Br	112.2	23.9	2.04
n-C ₄ H ₉ Br	107.4	23.8	1.93
n-C ₅ H ₁₁ Br	113.7	33.0	1.95

The difference between the bromides and iodides is striking. The moments of the *n*-iodides increase as far as the butyl compound and then preserve a constant value, while those of the *n*-bromides show no increase beyond *n*-propyl bromide. Although the moments of the iodides are slightly lower than those of the corresponding bromides, the increase thus extends over a further carbon atom in the former. Both the *i*-propyl compounds possess larger moments than their isomeric *n*-compounds.

The increases in moment with extension of the carbon chain shown by the vapours are larger and apparently continue to higher members of the series. The measurements in solution are complicated by the effect of the principal dipole upon the surrounding solvent molecules, as well as by its influence upon other parts of the polar molecule. For compounds of the present type, the first effect should give rise to an induced moment which opposes the principal dipole of the molecule^{5,6}, whereas the moment induced in the second case should either increase or decrease the total moment according as additional polarizable matter is brought within or outside two cones of semi-angle 55° about the dipole axis⁶. Lengthening of the hydrocarbon chain would to some extent add CH₂ groups in this space, and the percentage increase in moment in homologous series should be uniform. That this conclusion is not confirmed by experiment is probably due to the necessary approximations in the theory.

The contributions to the resultant moment of the molecule of the moments induced by the primary dipole in the parts without and within the cones would differ with the polarizability and size of the halogen atom, and the secondary effects produced by addition of CH₂ groups would probably vary in the two cases. The polarizability and size of the iodine atom exceed those of the bromine atom, and it is in the iodides that the greater inductive effect is shown.

It seems that the polarizability of the polar group is a more important factor than the magnitude of the principal dipole in determining the change of moment in these series. This is also shown by the fact that the polarizability of the nitrile group is smaller than that of the iodo-group and, although it possesses a greater moment, the percentage variation of the moment in the nitriles is smaller and the moment attains its limit more quickly than in the iodides.

A fuller account of these results will shortly be published.

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J. R. PARTINGTON.

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Cowley and Partington, *J. Chem. Soc.*, 1252 (1933); 604 (1935).

² Groves and Sugden, *J. Chem. Soc.*, 158 (1937).

³ See *Trans. Faraday Soc.*, 30, Appendix p. 21 (1934).

⁴ Cowley and Partington, *J. Chem. Soc.*, 1184 (1936).

⁵ Cowley and Partington, *J. Chem. Soc.*, 130 (1937).

⁶ Frank, *Proc. Roy. Soc., A*, 153, 171 (1935).

⁷ Higasi, *Sci. Papers Inst. Phys. Chem. Res., Tokyo*, 22, 254 (1936).

Potato Flowers and Dissemination of Potato Viruses

THE exact method of the spread of virus X in the field is not yet known. It has been suggested, however, that a species of thrips is the vector and that infection is conveyed by the insect feeding in the flowers¹.

In the returns issued by the Department of Agriculture for Scotland¹, there are fourteen potato varieties which flower sparingly or not at all. Four of these, Arran Crest, Epicure, Ninetyfold and King Edward, are necrotic to virus X when infected artificially through graft unions, and field crops are invariably free from infection. The remaining ten varieties, Duke of York, Eclipse, Sharpe's Express, Witchhill, Great Scot, Royal Kidney, Arran Banner, Arran Chief, Arran Consul and Rhoderick Dhu are non-necrotic, and analyses of samples drawn from commercial stocks have shown that virus X is of common occurrence within them. Of the free-flowering varieties in commerce, none is necrotic to virus X and none is X-free. It would seem, therefore, that the absence of virus X in commercial stocks is more closely related to the necrotic reaction than to the absence of flowers.

In support of this view, there is the observation that the necrotic disease is rarely, if ever, seen in the field, a fact which receives partial explanation on the grounds that as the necrosis is lethal, perpetuation of diseased plants vegetatively is eliminated. There is also experimental evidence derived from artificial methods of infection to suggest that entry of the virus into varieties to which it is lethal does not take place readily through means of infection other than a graft union.

The possibility of a species of thrips acting as a vector of virus is in no way invalidated by this criticism of the locus of entry.

The position with regard to virus A, of which *Myzus persicae* is the vector², is very similar to that of virus X. Of the forty-six varieties listed in the agricultural returns³, seventeen are necrotic to virus A and are free from the virus under natural conditions. Ten of these varieties seldom produce flowers and seven are free-flowering. Of the twenty-nine non-necrotic varieties, three non-flowering and five flowering varieties are usually found to be infected with virus A, whilst the virus is not uncommon, either alone or in combination with other viruses in the remaining twenty-one varieties. It seems clear, therefore, that the factor determining the presence or absence of virus A is the reaction of the variety to the virus and not the presence or absence of flowers.

Evidence with regard to non-necrotic aphid-borne viruses has been obtained from a series of controlled field-trials in which free-flowering varieties were kept disbudded throughout their growing period. Twenty plants of each of eight varieties were interplanted with leaf-roll infector plants. After one season of exposure, 46 per cent of the flowering controls and 49 per cent of the disbudded plants had contracted infection. At the end of a second season the infected plants had increased to 68 per cent of the flowering controls and 75 per cent of the disbudded plants. It would seem, therefore, that the presence of flowers *per se* has little effect on dissemination of potato virus diseases.

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Nov. 24.

¹ Smith, K. M., "A Text-Book of Plant Viruses", p. 343 (1937).

² *Sci. J. Agric.*, 29, 92-93 (1937).

³ Loughmans, J. B., *NATURE*, 121, 838 (1933).

Mechanism of Polyploidy through Colchicine

THE action of colchicine on plant nuclei has been studied in stamen hairs of *Tradescantia reflexa*. Ovaries with attached filaments from which the pollen sacks had been removed were submerged in a salt sugar solution in which checks will survive more than 48 hours. Colchicine in concentrations ranging from $2 \times 10^{-4} M$. to $6 \times 10^{-3} M$. inhibits spindle formation and thus prevents anaphase. The drug slows down, but does not inhibit, the normal chromatin changes. Thus the split metaphase chromosomes commence to shorten and swell. Chromonemata become visible within them. Gradually they assume interphase structure. Meanwhile, chromosomes may have assumed various positions within the cell. Single chromosomes or groups of few chromosomes may have separated from the main group. The reconstruction of the amphidiploid colchicine nucleus thus at first leads to an irregular contour, which is gradually lost; micronuclei may be formed.

In summary, colchicine specifically inhibits anaphase, so that polyploid nuclei originate through reconstruction of an interphase nucleus from metaphase chromosomes, wherever plant cells divide under the influence of the drug.

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Rotational Analysis of the Visible O_2^+ Bands

THE visible O_2^+ bands obtained by a heavy discharge through helium containing a small amount of oxygen have been photographed in the second order of a 21-ft. grating.

Examination of the bands, λ 5632 (1, 0), λ 6026 (0, 0) and λ 6419 (0, 1), shows that each consists of four components containing in all thirty-nine branches. The alternate lines in each branch are missing and the structure agrees with the ${}^4\Sigma_g^- \rightarrow {}^4\Pi_u$ transition predicted for these bands by Mulliken¹. The missing lines at the origin show that the ${}^4\Pi$ level is inverted. The Λ -type doubling is greater in the ${}^4\Pi_{1/2}$ than in the ${}^4\Pi_{3/2}$ state, increasing with J in each case, and is very small in the ${}^4\Pi_{1/2}$ and ${}^4\Pi_{3/2}$ states.

The fine structure of the ${}^4\Sigma$ level agrees with Budó's² theory. The F_1 level is blended with F_2 , and F_3 with F_4 , while F_1 and F_2 are separated by a constant interval from which $\epsilon = 0.146$ and $\gamma \sim 0$. The effect of this structure is to reduce the total number of branches to be expected for the transition from 48 to 40.

Preliminary values of the molecular constants obtained from the analysis are as follows:

$$\begin{aligned} A &= -46.9 \text{ cm.}^{-1}, B_e' = 1.202 \text{ cm.}^{-1}, \alpha_e' = 0.027 \text{ cm.}^{-1}, \\ D_e' &= -6 \times 10^{-4} \text{ cm.}^{-1}, r_e' = 1.274 \times 10^{-8} \text{ cm.}, B_e'' = \\ 1.108 \text{ cm.}^{-1}, \alpha_e'' &= 0.018 \text{ cm.}^{-1}, D_e'' = -5 \times 10^{-4} \text{ cm.}^{-1}, \\ r_e'' &= 1.346 \times 10^{-8} \text{ cm.} \end{aligned}$$

A complete account of the analysis of these and of the (2, 0) band will be published shortly.

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Nov. 18.

¹ Mulliken, *Rev. Mod. Phys.*, 4, 51 (1932).

² Budó, *Z. Phys.*, 105, 75 (1937).

Volume-Rectification of Crystals

It has been shown by Khastgir and Das-Gupta¹ that crystals like carborundum, silicon and zincite, which have no centres of symmetry, give volume-rectification when placed between mercury electrodes; whereas with symmetrical crystals, for example, galena and iron pyrites, they did not find this rectifying effect when the crystals were similarly placed with large area of contact between mercury electrodes. Experiments conducted in our laboratory have, however, shown the existence of the so-called volume-rectification in galena, iron pyrites and pyrolusite placed between mercury electrodes.

While it is further expected that all rectifying crystals should show the same effect, our investigation has also given indications which tend to show that either both surface-rectification and volume-rectification (if there be really any volume-rectification) must be coexistent in all rectifying crystals, or the whole phenomenon of rectification is only a surface effect.

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Bengal. Nov. 10.

¹ *Ind. J. Phys.*, 9, 258 (1935).

Bright Meteor of November 9

WITH reference to the note in *NATURE* of December 11, p. 1009, on the meteor observed on November 9, I observed this object at 21h. 26m. G.M.T. while engaged on meteorological work at Hastings. My attention was first directed to a reddish light in a direction west by south of my observation point; this suddenly burst into a brilliant metallic blue head which continued for one or two seconds before vanishing. The light was quite brilliant and resembled a magnesium flare. An interesting feature was that the meteor was of sufficient size to leave a very distinct streak; this was of an ashy grey colour and persisted for 7-10 seconds, growing gradually fainter.

The meteor became visible at an elevation of about 60° and vanished at about 30°. Its deviation from a vertical line from zenith to horizon was in the region of 10° towards the north.

A. E. MOON.

30 Clive Avenue,
Hastings.
Dec. 13.

Points from Foregoing Letters

PHOTOGRAPHS showing a 'divided' aurora with the upper part of the rays in the sunlit and the lower part in the dark atmosphere, with a dark space occurring at the boundary, are sent by Prof. C. Störmer. The photographs were taken simultaneously in different localities. It appears that the aurora is extinguished at the boundary of the sunlit atmosphere but recovers farther down.

Graphs giving the number of silver atoms liberated from silver halides by the action of light, for each molecule of a 'sensitizing' dye present, are submitted by Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker. The new results confirm those of previous investigators in showing that a single molecule of adsorbed dye gives rise to a large number of silver atoms, but differ in that they indicate that only a portion of the dye molecules are active.

A new oxidation catalyst is announced by J. G. Dowan and D. E. Green. Its presence was detected in the centrifuged insoluble sediment from a phosphate extract of washed and ground muscle, which increased the rate of oxidation of reduced coenzyme I (in the presence of methylene blue, flavin, etc.). The new 'coenzyme factor' is destroyed by heating for 15 min. at 52° C. It is not identical with flavo-protein or any known 'carrier'. Practically every dehydrogenase known in animal tissues can be resolved into two catalytic components, one soluble and the other insoluble. The insoluble 'coenzyme factor' may be considered as a dehydrogenase which specifically catalyses the oxidation of reduced coenzyme by 'carriers'.

Tables showing that the presence of hydrogen (1-5 per cent) or of water vapour (1-2 per cent) increases by several per cent the flame temperature of (25 per cent) carbon monoxide-air mixtures, are submitted by Prof. W. T. David and B. Pugh.

Dr. D. Brown points out that if sound-film is prepared under certain specified conditions, and the striations on the sound track used as a diffraction grating with monochromatic light, a Fourier analysis is achieved resulting in an acoustic spectrum of

the original sound. One of the applications which is suggested refers to the study of transient sounds.

The compressibility of heavy water is found by Prof. S. Bhagavantam and B. S. R. Rao to be very nearly the same as that of ordinary water, and the ratio of the isothermal to the adiabatic compressibility very close to unity, as in the case of water.

The time drift of net assimilation rate in plants is discussed by R. F. Williams. His results show a fall in the rate during vegetative growth; this fall is independent of the drift in mean maximum temperature. These results are not in agreement with recent findings of Heath and of Gregory.

The polarizations and dipole moments of various organic (alkyl) compounds of bromine and iodine have been redetermined by E. G. Cowley and Prof. J. R. Partington, who discuss the influence of the lengthening of the carbon chain and of the surrounding solvent molecules. It appears that the polarizability of the polar group is a more important factor than the magnitude of the principal dipole in determining the change of moment in these series. The polarizability and size of the iodine atom exceed those of the bromine atom.

From an examination of non-flowering and flowering potato varieties, Dr. G. Cockerham has found no direct relationship between the absence of flowers and freedom from potato viruses.

The effect of colchicine (an alkaloid obtainable from meadow saffron) upon nuclei in process of division in plant cells is briefly described by B. R. Nebel. The drug slows down chromosome changes, inhibits spindle formation and prevents the anaphase stage, so that polyploid nuclei (containing a larger number of chromosomes) are formed.

The existence of the so-called volume-rectification has been found by B. K. Sen in crystals other than those having no centre of symmetry. In the course of his investigation, indications have also been found suggesting that the phenomenon of rectification is only a surface effect.

Research Items

Origin of the Long Barrow

THE problem of the origin and affinities of the British long barrow, of which the trapezoidal mound is a persistent feature, hitherto eluding search elsewhere, is discussed by Mr. Stuart Piggott in the light of evidence from Brittany in *Antiquity* of December. It had seemed clear that the long barrow was a member of the megalithic tomb complex which extends from Iberia to Orkney; and comparisons had been instituted with remains in Brittany; but it was difficult to present convincing Continental parallels for the whole specialized English long barrow type. It was, however, recently pointed out that the distribution pattern suggested a movement from Armorica to Dorset. Field and museum work in southern Brittany during the past summer have suggested Breton equivalents in a group of tombs on the plateau of Manio to the north-east of Carnac, in which appear long low mounds, peristaltic and dry-walled structures. A similar group of cairns was excavated by Miln near Crucun in 1878. These also showed evidence of the quadrangular mound with enclosing wall and remains of stone structures within the area. These, it is noted, are not megalithic in the true sense. The evidence of the pottery in the grave goods points to an early date. It stands nearest of the Breton pottery to the 'undifferentiated ancestral continuum' of the Westischekeramik postulated by Childe and equated by Mrs. Hawkes with Vouga's "neolithique ancien" and the undecorated wares of Chassy and our English Neolithic A. i. It seems impossible to escape from the conclusion that this is the Breton representative of this early Neolithic culture, a further relation with the important Neolithic subgroup established at Hambury Fort in Devonshire being suggested by the occurrence in Brittany of the 'trumpet lug' found in Devon and other sites of the west of England and here regarded as a type fossil.

'Minnesota Man'

IN an analysis of the report by Dr. A. E. Jenks on 'Minnesota Man' (see *NATURE*, Oct. 2, p. 596) Dr. Alés Hrdlička criticizes the author's finding as to the antiquity and racial character of this skeleton (*American J. Phys. Anthropol.*, 22, 1937). There is, it is maintained, no certain geological evidence to indicate a Pleistocene age, while the characteristics of the skeletal remains point to a Sioux origin. As regards the geological evidence, there is a serious and irreparable uncertainty as to the original status of the ground above and immediately about the skeleton. All the circumstances point to a burial rather than a deposit after drowning. The generalizations in regard to man's coming to America in glacial times seem too categorical. The evidence is against a land-bridge between Asia and America in Pleistocene times. Mineralization of the bones has only a secondary relation to age. As regards the morphological evidence of the skeleton, in the various features enumerated as unique, unusual or primitive, Dr. Jenks is in part correct, but in part has been misled by defects in the parts, by the immature state of the skull and bones, through lack of sufficient comparative material or through over-concentration on small details. A re-examination of forty-one female Sioux skulls in the

National Museum collections leaves no uncertainty as to the Minnesota skeleton and its appurtenance. Its type is the characteristic type of the Sioux, which differs substantially from that of other North American Indians. As a Sioux, the skull and skeleton cannot possibly be assumed to be twenty, or ten, or even a few thousand years old. No Sioux sites show accumulations which would represent any such period; and on the other hand, though Minnesota was Sioux country, it could not be assumed that any type of American man could have remained in the same limited territory for thousands of years, and that without modification.

Phosphorylation and Respiration

EVIDENCE is now accumulating to the effect that phosphorylations by animal tissues depend on an intact respiratory system. This is shown very clearly in recent observations by H. Kalckar (*Enzymologia*, 2, 47; 1937) on phosphorylations by kidney cortex tissue. The accumulation of phosphoric esters, consequent upon phosphorylation, was shown after the addition to the tissue of fluoride which inhibits kidney phosphatase. It was found that such esters only accumulated under aerobic conditions; under anaerobiosis no phosphorylation could be demonstrated. The addition of cyanide (N/1000) to the system under aerobic conditions inhibited respiration and phosphorylation to the same extent. The inhibition of phosphorylation by anaerobiosis disappeared when oxygen was allowed to re-enter the system. The phosphorylated product from kidney cortex in presence of glucose, phosphate and fluoride was found to be fructose diphosphate. Similar results were found to take place with minced liver tissue.

Food of the Little Owl

"SWEEPING statements about the damage done by the Little Owl have little justification in fact" is the interesting judgment made by the committee of scientific investigators reporting on the recently completed national survey on the food of the little owl (*Athene n. noctua*) conducted by the British Trust for Ornithology during the past two years (*British Birds*, November 1937). Despite the controversy over the food of the little owl, the repeated claims by gamekeepers and others that the bird was vermin and a great destroyer of pheasant and game chicks, and several statements that it was responsible for the extermination of nightingales in districts, the committee is of the unanimous opinion that the destruction of game, poultry or wild birds is negligible, and that, except in abnormal circumstances, the owl feeds wholly on insects and small mammals. The survey was conducted with the detailed thoroughness of previous surveys, and from March to July 1937 special studies were made on little owls nesting in game-rearing districts in 11 counties. In the general survey, which was under the organization of Miss Alice Hibbert-Ware, of Girton, Cambridge, 73 experienced field naturalists sent pellets, gizzards and larder- and nest-contents from 34 counties. In all, 2,460 pellets, material from 76 nests, and 28 gizzards of little owls were examined. Insects were in 23 gizzards, rodents in 11 and birds in five.

Fossil Insects from the Permian of Kansas

SINCE the death of Dr. R. J. Tillyard, several important contributions by him have appeared in the *American Journal of Science*. It is only possible to mention two of these very briefly here. In the issue of April 1937, he deals with the only true Embiid so far found in Kansas Lower Permian rocks. This form is named *Protombia permiana* gen. et sp. nov., and is regarded as constituting the new suborder Protombriaria. This fossil has as its nearest related living form *Olatoda*. From the presence of an ovipositor and large compound eyes it is concluded that it was not a web-spinner to the extent that prevails among recent forms. The fore-tarsi, which normally contain spinning glands, are, however, missing from this fossil. In the September issue, Dr. Tillyard discusses the cockroaches or Blattaria from those same rocks. The most interesting feature here brought to light is the description given of the complete hind-wing of a Palaeozoic cockroach for the first time. The configuration of the wing in the genus *Pycnoblattina* is regarded as proving that the latter is ancestral to the archaic living termite *Mastotermes*. The conclusion is reached that the termites or Isoptera as an order were directly descended from the fossil cockroach family Spiloblatinidae.

A New Hydroid from Norway

COLLECTIONS of the bottom fauna from two localities on the west coast of Norway, where deposits of mud occurred, at a depth of from 10 to 40 metres, have revealed the presence of a minute and curious hydroid. In his description, Einar Westblad points to certain simple or primitive characters of this form: its small size, 1-1.5 mm.; its few tentacles, four normally but exceptionally three; the tetramerous arrangement of the ground plan; and the absence of perisarc (Arkiv. Zoologi, 29 B, No. 7; 1937). For the specimens, a new genus and species have been created, *Boreohydra simplex*, regarded by the author as a form intermediate between *Protohydra* and the more highly developed hydroids, falling into the same family of the Athecata as *Protohydra*. It is a curious feature of the species that it has no method of adhesion to a substratum, but lives with the lower end of the body simply embedded in the mud, after the manner of a newly settled larva of a cerianthid sea-anemone.

Drying of Plant Materials

ALTHOUGH the drying of plant materials is widely practised commercially, the underlying principles have received comparatively little investigation. The experiments on factors affecting the rate of hop drying described by A. H. Burgess (*J. Inst. Brewing*, 43; 1937) are therefore necessarily of a fundamental nature. From previous work, a formula has been developed showing the effect of atmospheric humidity, temperature, air speed and depth of loading upon the rate of drying, from which the time required for drying hops at constant temperature can be calculated. In practice, however, it is necessary to raise the temperature gradually as drying proceeds, and in the present paper it is shown how this rise influences the time required for drying, and methods are described by which the time can be computed under such conditions. Although it has hitherto been generally accepted that the rate of evaporation is independent of the temperature of the air, heated air, such as is used in hop drying, is shown to promote

evaporation by transmitting heat to the hops. Further, the actual moisture-absorptive capacity of the air, which increases as its temperature rises, also influences the rate of drying. The total rate of evaporation from a very shallow layer of hops is proportional to the 0.39 power of the air speed.

Ecology of Sooty Mould Fungi

SOOTY moulds consist of a number of different species of fungi growing together. The constituent organisms may be associated closely, or may be segregated, but their general appearance resembles a black felt of hyphae. Miss Lilian Fraser has studied "The Distribution of Sooty Mould Fungi and its Relation to Certain Aspects of their Physiology" (*Proc. Linn. Soc. N.S. Wales*, 62, Pts. 1-2, 1937). The ecology of such composite moulds naturally depends upon the existence of conditions which are suitable for all the constituent fungi. Cultural requirements of a number of the commoner species are set forth in the paper, and various characteristic associations are described. Growth is usually slow, except during periods of damp weather. The 'honey-dew' produced by many scale insects is a good medium for the growth of sooty moulds, but discourages such ubiquitous fungi as *Penicillium*. Its chief constituent is adonite, which is apparently responsible for its suitability.

Diploid and Haploid Colonies of a Yeast

FROM a commercial yeast consisting of a strain of *Saccharomyces ellipsoideus*, a single cell was isolated, and from its descendants various cell and spore cultures were derived which throw light on the life-history of this species (Winge and Laustsen, *Comptes Rendus, Lab. Carlsberg, Serie Physiol.*, 22, No. 6). By using a microdissection technique, the four spores from an ascus were isolated and cultivated. Normally they conjugate in pairs, forming diploid colonies. Isolated spores may germinate in two ways: (1) to form colonies of rounded (torula) cells with (evidently) haploid nuclei, some of which may later conjugate to form diploid colonies of elongated cells; (2) directly on germination an internal fusion of two nuclei may take place, producing at once elongated cells which are diploid. On plaster, the round haploid cells form no spores, whereas the elongated diploid cells function at once as sporangia. The colonies derived from the four spores of an ascus show genetic segregation and probably crossing-over. The four giant-colonies from an ascus do not necessarily show segregation in pairs. In one case the resulting colonies were all different, one being like the parent colony, one with concentric furrows and marginal scallops, one with deep radiate furrows, and one smooth, conical in shape and remaining persistently haploid. Sectoring was also observed. It is thus clear that diploid cells are normally heterozygous and will show segregation in later spore generations.

Atomic Weight of Neodymium

THE considerable difference between the international atomic weight of neodymium (144.27) and that obtained by Aston with the mass-spectrograph (143.5) has led Hönigschmid to carry out a re-determination of this constant by the chemical method (*Naturwiss.*, 25, 701; 1937). Two neodymium preparations were used. X-ray spectroscopic analysis showed that they contained no other rare-earth elements in greater quantity than 0.04 per cent.

Neodymium trichloride was analysed, and as a mean of a large number of concordant results the value 144.27 was obtained for the atomic weight, in exact agreement with the international value at present accepted. The difference between the physical and chemical values is probably due (as suggested by Aston) to the existence of two heavy isotopes of neodymium of mass 148 and 150 (A. J. Dempster, *Proc. Amer. Phil. Soc.*, 75, 735; 1935), recently confirmed by Dempster (*Phys. Rev.*, [ii], 51, 289; 1937).

Action of Nitrous Acid on Amines

THE mechanism of the reaction between nitrous acid and amines is difficult to investigate owing to the instability of nitrous acid and the ease with which the initial products of the reaction undergo secondary changes. The reaction has, however, been studied by many workers, and most recently by J. C. Earl and N. G. Hills (*J. Proc. Roy. Soc. New South Wales*, 70, 322; 1937). The diazotization of aniline in methyl alcohol solution has been studied by dilatometric and conductimetric methods. The results show that the course of the initial reaction is the same for methylaniline as for aniline. The later stages of the reaction involve a rapid increase in hydrogen ion concentration. The reaction may occur between anilinium ions and nitrous acid, but an alternative explanation is that an initial reaction of which the velocity is increased by increasing hydrogen ion concentration proceeds until a critical concentration of the first reaction product is reached. This compound then decomposes, giving hydrogen ions, and causing a rapid decrease in volume and increase in conductivity.

Solvent Dewaxing

A GROUP of papers on solvent dewaxing was presented at a meeting of the Institution of Petroleum Technologists on November 9. M. Ba Thi, T. G. Hunter and A. W. Nash dealt with the subject from the phase-rule aspect, consideration being given to the use of double solvents, such as amyl alcohol/naphtha, which are completely miscible with oil at the dewaxing temperature. Representation by means of tetrahedra of simple quaternary systems of four independently variable components was described and application of these principles to equilibria in oil-wax-solvent mixtures discussed. Data deduced from such diagrams for the solvent-oil ratios employed were shown to be in agreement with experimental figures. Dr. Bruno Engel described dewaxing with chlorinated solvents, such as dichlorethane, and gave instances of distillates and residues derived from different crudes which have been dewaxed by the use of such solvents. Oils rich in asphalt and resins have been successfully treated. It has been found to be advantageous to carry out dewaxing in two or more stages, either by fractional precipitation of wax or by de-oiling the wax obtained. The cause of poor filterability and high oil retention of certain high boiling distillates was the subject of a paper by E. C. H. Kolvoort, F. R. Moser and C. G. Verver. In such cases, the wax has indefinite crystalline characteristics, suggesting the presence of branched-chain paraffins together with those of the normal type. A theory explaining how pour-point "depressors" prevent adsorption by such waxes was given. The advantages of methyl-*n*-butyl-ketone as a dewaxing solvent were indicated by O. S. Pokorny and R. K. Stratford. The authors gave data concerning wax solubility, miscibility temperature, vapour pressure,

stability, non-corrosiveness, non-toxicity, cost, etc., and concluded that the solvent should find a wide application for dewaxing purposes.

Metal-spraying

A PAPER by R. R. Sillifant, included in those of the recent Autumn Meeting of the Iron and Steel Institute, deals with the spraying of iron and steel with a wire-fed pistol. In normal circumstances the deposit consists of irregular particles flattened by the force of impact and surrounded by an oxide film which renders the deposit brittle. By using dissolved acetylene as the fuel gas in conjunction with nitrogen as the impelling medium, coupled with a suitable heat-treatment after spraying, steel deposits of high quality are obtained. Such a sprayed bar was bent cold through an angle of 90° without any sign of the dislodgement or fracture of the deposit. The technique employed is described, the heat-treatment for a deposit consisting of a steel containing 0.09 per cent of carbon being a two-hour heating at 900° C. The applications of the method in building up worn steel parts and possibly as a surface coating for cast iron are discussed.

Frictionless Torque-free Suspensions

FOR the measurement of minute forces, the torsion balance with a quartz suspension has proved invaluable. In his search for a still more sensitive instrument, Dr. F. T. Holmes of the University of Virginia has produced a magnetic suspension which he describes in the November issue of the *Review of Scientific Instruments*. A ferromagnetic needle is supported vertically with its upper end in the axis of and just below a vertical solenoid through which a current flows which is nearly sufficient to support the needle. The rest of the supporting force is provided by a smaller solenoid just below the former, and the current in it is so controlled as to make the needle stable. This is secured by providing the lower part of the needle with a cylindrical vane over the top of which a beam of light passes to fall on a photo-electric cell, the current from which operates an amplifier the output of which feeds the smaller solenoid. A downward motion of the needle admits of more light falling on the cell and the upward pull of the solenoid increases. Damping arrangements are provided. With a needle weighing 0.75 gm., a torsional couple of only 7×10^{-6} dyne cm. per radian was found and the author sees no reason why this should not be reduced considerably.

Hyperbolic or Spherical Space

DR. G. C. McVITTIE, in his recent monograph "Cosmological Theory", inferred that space is hyperbolic by an argument based on extrapolating Hubble's observations on the velocity-distance relations of the nebulae. Prof. E. Hubble himself (*Mon. Nat. Roy. Astro. Soc.*, 97, 506; 1937) has criticized this argument on the ground that the method used for extrapolation is unsatisfactory. Dr. McVittie has now shown (*Z. Astrophys.*, 14, 274; 1937) that Hubble's own methods of extrapolation imply hyperbolic space if the average mass of a nebula is taken to be 2×10^{10} times that of the sun. On the other hand, if the average mass is ten times this amount, then the magnitude of the probable errors in the observational formulae show that spherical space lies within the bounds of possibility. Of course, any argument based on extrapolation into regions of space not accessible to observation must be received with reserve.

Inland Water Survey in Great Britain

THE second annual report* (1936-37) of the Inland Water Survey under the Ministry of Health and the Scottish Office continues the story of the progress of the Survey since the date of the previous report. It points out the magnitude of the undertaking and the considerable amount of preliminary work which has been found necessary. The replies to the questionnaire circulated at the outset of investigations showed that relatively little of the varied mass of information in existence was suitable for the purposes of the Survey, and that not only were improvements necessary in the methods in vogue for gauging and recording levels in rivers and streams, but also that a large number of additional gauging stations was required. During the period under review, the efforts of the Committee and its officers have been directed towards the introduction of better methods of survey and to the examination and rearrangement of existing records suitable for publication in a form which would serve as a model for future investigations.

Emphasis is rightly laid on the importance of the functions of the new catchment boards in obtaining a full knowledge of river flows and their variations. In order to assist the catchment boards and others co-operating in the same direction, an instructional memorandum on the water survey of a river system was prepared and published in October, 1936. It is added that during the year an increasing interest has been shown in the Survey, but the comment is made that this interest tends to manifest itself only in regard to those parts of a record which are of most use to the persons or bodies concerned. This is, of course, perfectly natural; but it is obviously insufficient for the purposes of a complete survey. Thus the catchment boards show a disposition to limit their observations to periods of high discharge,

when flooding is liable to occur, and to ignore periods of relatively low discharge. But periods of low discharge are important for pollution prevention and to fishery authorities, and fundamentally so to water undertakers, so that a survey must be comprehensive in its records if it is to be of service to all classes of the community.

Underground water measurement is a branch of the work of the Survey which is being carried on with the assistance of the Geological Survey, and a tribute is paid to the late Dr. Bernard Smith, director of the Geological Survey, who took a great interest in the Inland Water Survey and acted as one of its assessors.

Assistance in hydrographical field work is being given by outside bodies and individuals; in particular, by schoolboys under the direction of their headmasters and geography masters. Their services are being utilized in the location and measurement of wells.

The examination of certain river basins in detail, begun in the previous year, has been continued, and observations of a preliminary character have been made during the twelve months in regard to the Ness Basin, the Tay, Ouse (Yorkshire), Severn, Dee (Cheshire), Irvine, Clyde and Kelvin. The results of these investigations are set out in the report and a well-merited acknowledgement is made of the pioneer work of Captain W. N. McClean in founding and directing at his own expense the organization known as River Flow Records, which has carried out discharge measurements in the Ness Basin and elsewhere during the past eight years.

The investigations made and collected from various sources are being "converted, amplified, corrected, extended and consolidated". It is announced that a selection, dealing with the results from twenty-eight gauging stations in respect of fourteen river basins in Great Britain, will shortly be published.

BRYSSON CUNNINGHAM.

* Ministry of Health and Scottish Office. Inland Water Survey Committee: Second Annual Report, 1936-37. Pp. 26. (London: H.M. Stationery Office, 1937.) 6d. net.

Research Grants of the American Academy of Arts and Sciences

INCOME from the Permanent Science Fund of the American Academy of Arts and Sciences, according to agreement and declaration of trust, shall be applied to such scientific research as shall be selected . . . in "such sciences as Mathematics, Physics, Chemistry, Astronomy, Geology and Geography, Zoology, Botany, Anthropology, Psychology, Sociology and Economy, History and Philology, Engineering, Medicine and Surgery, Agriculture, Manufacturing and Commerce, Education, and any other science of any nature or description whether or not now known or now recognized as scientific; and may be applied to or through public or private associations, societies, or institutions, whether incorporated or not, or through one or more individuals."

Applications for grants under this indenture are considered by a committee of the Academy on stated dates only. The next such meeting will be to consider applications received in proper order on blank forms furnished by the committee on March 1, 1938. Correspondence, including requests for application forms, should be addressed to the chairman of the Committee on the Permanent Science Fund, Prof. John W. M. Bunker, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Grants-in-aid from this fund were voted by the Academy on November 10, 1937, as follows:

Prof. Charles Chupp, Cornell University, 400 dollars, to aid in finishing a monograph of the fungus genus *Cercoaspora*.

Dr. Willi M. Cohn, research lecturer, University of California, 150 dollars to be used in printing, in the *Astrophysical Journal*, the results obtained on the polarization of the solar corona in the 1932 and 1934 eclipse expeditions.

Prof. Ada R. Hall and Helen W. Kaan, Wellesley College, 59 dollars, to assist in a histological investigation of the development of thyroid glands in rat embryos.

Prof. Robert S. Harris, Massachusetts Institute of Technology, 300 dollars, for the purchase of mothers' milk, to be used in an investigation of (a) the chemistry of the casein; (b) the antirachitic properties.

Dr. Francis R. Hunter, Rhode Island State College, 250 dollars, towards the purchase of a Barcroft-Warburg micro-respirometer, to be used in a comparative study of respiration and permeability.

Prof. Walter Landauer, Storrs Agricultural Experiment Station, 150 dollars, for the purchase of an analytical balance to be used in connexion with a quantitative study of growth in lethal embryos of creeper and Cornish fowl.

Dr. Clarence C. Little, director of the Roscoe B. Jackson Memorial Laboratory, 1,000 dollars, to be used

to study the incidence of tumours and other growth abnormalities in a species cross in mice.

Dr. Karl E. Mason, Vanderbilt University School of Medicine, 500 dollars, for technical assistance in the development and standardization of trustworthy methods for the routine assay of food substances for their vitamin E content.

Prof. Arthur F. Scott, Reed College, 500 dollars, for the purchase of apparatus to be used in determinations of the atomic weights of beryllium and bismuth.

Drs. Kurt G. Stern and Abraham White, Yale University School of Medicine, 400 dollars, to be used for the construction of equipment for the study of the homogeneity and certain physical properties of highly purified protein preparations and protein derivatives.

Dr. John H. Welsh, Harvard University, 200 dollars, to enable him, during his sabbatical leave, to visit the laboratories of Prof. Koller at Kiel, and Prof. Hanström at Lund.

Prof. William F. Windle, Northwestern University Medical School, 500 dollars, for employing the services of a trained laboratory assistant in a study of neurological factors in the development of foetal respiration, and other general problems of foetal behaviour.

Foundations of Terrestrial Life: The Soil and the Green Plant*

THE ideas which I want to put forward may perhaps be indicated best by telling how and by what slow stages they grew up in my mind. A long time ago the late Prof. Gamble and I spent a very long time trying to find out how the green cells which give colour to the marine worm *Convoluta roscoffensis* get into the body of the animal, how they manage to increase and multiply there, and what is the impetus which drives them into the association. The conclusion which we reached as to the significance of the association between *Convoluta* and its green cells is nitrogen hunger. The symbiosis is only one of innumerable examples of the universal fact that the world of plants suffers, and has always suffered, from an insufficiency of nitrogen.

A good many years later, just after the Great War, the late Lord Melchett (then Sir Alfred Mond) and I spent a lot of time trying to improve the farmland surrounding Melchet Court. There was plenty of scope on soil which when it was not gravelly was clayey, and even when it wasn't was panned. Among other things, the effects of nitrogen and other fertilizers were tried on the grass land, and met with a success which was astonishing. In those days nitrogen was generally supposed to be bad for grass land. It was thus proved, however, to be wonderfully good, and that even when the poor grass land was supplied with a complete fertilizer and limed as well, the addition of more nitrogen produced more grass.

About that time, Sir Alfred Mond was taking a practical interest in the synthetic manufacture of ammonia, and there is no doubt that the results of our experiments on the value of nitrogen on grassland had something to do with his asking me

to give up an Oxford professorship and become director of agricultural research in the company which had been formed recently to develop the process at Billingham. The Research Station at Jeallot's Hill was established, and with the aid of colleagues I laid down and conducted a world-wide programme of experiments on the effects of nitrogen and other fertilizers on grass and arable land.

The next step in the development of my ideas was reached when on a visit to Ireland I was shown by one of our staff the almost incredibly swift response to nitrogen that rough, boggy, hillside grazings were making. Sedges and weeds of all kinds with scarcely any grass or clover began to disappear in a season or two, to be replaced by grasses and clovers, with the result that where before no grass grew there was soon good grazing.

The final step was reached in the course of feeding experiments with dried grass made at Jeallot's Hill. The results of the experiments showed that the winter milk of cows fed on a liberal ration of dried grass produced a butter with all the virtues of summer butter in it.

Looking back along this long, tortuous road, I find it difficult to believe that anybody could have been so slow to reach the conclusion to which it leads, or could require so much material on which to base a hypothesis which ought to have jumped to the mind long ago. The hypothesis is that the health and strength of people and their evolution, and the permanence of human societies depend on the soil and the green plant. The conclusions are that if the world has got on so well as it has with a half-starved vegetation and a hungry soil, how much better might it not get on when these deficiencies are discovered and made good.

F. KEEBLE.

* The argument introduced in a series of three lectures delivered at the Royal Institution on November 30 and December 7 and 14.

Museum Study of Man and his Work

A PAPER by Mr. de La Valette at a joint meeting of the Royal Society of Arts and the India Society on December 14, on the subject of Holland's colonial museums, raised the vital issue of the clash between the new tendency in science to co-ordinate its various branches devoted to the study of mankind and his works, and the old methods of museum arrangement which kept them severely apart.

This scientific humanism, as we may term it, though it is generally referred to as ethnography, covers much of the ground formerly divided up academically between the subjects of ethnology, anthropology, archaeology, geography, history and art. It takes a group, racial or cultural, and studies it as a whole. In Holland, the makers of museums have adopted this point of view with enthusiasm, and have either altered drastically the old differently classified and over-crowded museums, or have built and endowed large new museums especially for the study and appreciation of the peoples and cultures of their overseas empire.

The Colonial Institute at Haarlem enables the Dutch people—students and ordinary citizens—to be initiated into the ancient civilizations embraced by their colonial possessions. Here man is not divorced from his inventions, his art and his accessories. He is shown, not as a 'laboratory specimen', but as a living human being whose racial features, geographic and climatic conditions and particular means of subsistence have forced him to live, dress, create—both in a religious and a material sense—in a manner peculiar to him. Films, lectures, photographs, booklets written by scholars and experts, fill out the picture and make the impact of new knowledge both sharper and deeper. The existence of this museum is almost entirely due to the acumen and enthusiastic enterprise of private individuals—bankers, colonial merchants, collectors and so forth.

Much the same policy is pursued by the Ethnographical Museum at Leyden, which is State supported

and controlled by the University of Leyden. Here is an immensely rich collection of Indonesian religious art and textiles, but although æsthetic values are brought out so far as possible by architectural means, judicious lighting and dramatic placing, yet these exhibits—the apex of a culture—are shown in their relation to the whole. They are not chunks broken off, so to speak, and existing in a vacuum.

In Great Britain the story is very different. The Victorian passion for collecting and labelling specimens has given us magnificently large, well-stocked museums, the policy and arrangement of which are still the old ones of dry scholastic classification. Objects are related in kind and time, but are divorced entirely from the men who made and used them. The only exception to this rule is the India Museum, part of the Victoria and Albert massif, which, under its new curator, Mr. K. de B. Codrington, is endeavouring to pursue this modern policy of co-ordination of all aspects of a nation's (in this case, a sub-continent's) civilization. There is serious talk, however, of this forward-looking policy being abandoned, the collection broken up, and the objects scattered, according to their ethnological, artistic or historic interest, through the various institutes of South Kensington.

Mr. de La Valette ended his talk with a strong bid not only for the continued existence of the India Museum as an entity, but also for a larger, really comprehensive India Museum on the same lines, which would combine its own collection with that of Indian and Indian-influenced objects belonging to the British Museum. This suggestion was supported by Sir Robert Witt (chairman), Lord Amulree and Sir James McKenna, among others. Sir A. Ramaswami Mudaliar made a moving plea that his great country should be studied sympathetically, and that its ancient art and culture, and its present development, should in England have a setting worthy of the Indian Empire.

Science in Radium Therapy

THE annual reports, which the Medical Research Council has now issued since 1923, enable the reader in retrospect to see how the methods of treatment of disease by means of radium have been evolved from frank experimentation to a procedure based on some, though limited, knowledge of the reactions of living tissues to radiation and supported by precision data on dosage.

The current report, No. 226 of the Special Report Series, "Medical Uses of Radium", is a summary of the work of the Council's research centres for 1936 (London: H.M. Stationery Office). The general scope of the experimental section, pp. 7-16, includes work of a purely physical and biological nature, that of the clinical section being largely concerned with the methods and results of treatment of malignant disease. A section on the treatment of simple metrorrhagia, pp. 37-38, is, however, not only of great

clinical interest, but also affords a good example of the way in which a successful form of treatment has been evolved by the method of trial and error, with still no certainty as to the essential processes set into operation by radiation. As stated in the report, 837 cases have been under observation at the Marie Curie Hospital for from one to ten years, and of these 97 per cent of the menopausal cases and 78.5 per cent of the younger patients have remained well without further treatment. Yet there is no very definite evidence as to the relative importance of the actions of the rays upon (1) uterus and (2) ovary.

By reference to this and earlier reports, the reader can quickly see the chief methods in use in the treatment of cancer of the breast, uterus, mouth, nasopharynx, larynx, œsophagus and rectum. Not only so, but for each one of those sites there are statistical

data giving the results of treatment, ranging in some cases over so much as fifteen years, and rarely so little as five. The data, taken in conjunction with those issued by the National Radium Commission, are in effect the answer to the question: What is the value of radium in the treatment of cancer? There are sites, such as the œsophagus and rectum, where the data show that a permanent improvement in the condition is not as a rule to be expected. On the other hand, a patient exhibiting an early stage of the disease in cancer of the cervix uteri is after suitable radium treatment more likely than not to be free of the disease five to six years later.

Methods change, and the tendency for the last few years has been to avoid interstitial methods and replace them by the use of radium outside the body. Teleradium has been practised by several centres in Great Britain over a period of years, and an interesting account is given of the clinical uses of a one gram unit at the Middlesex Hospital.

Reference to the experimental section shows that researches essential to our understanding of the biological actions are being undertaken by several groups, notably at the Strangeways Laboratory at Cambridge, the Imperial College of Science and Technology, the Royal Cancer Hospital, the Mount Vernon Research Centre and at the Middlesex Hospital. As stated in the introduction, with leading principles being established, the make-shift ground of empiricism gives way to a surer basis of therapy. That basis is quickly becoming a scientific one, in the sense that doses of radiation are now prescribed and dispensed in a quantitative manner; this has been brought about only by long effort, an important step being the establishment of the roentgen as an X-ray unit. The Medical Research Council, systematically and over a course of years, has aided the work of the British X-ray Unit Committee, which had much to do with fixing the value of the unit now in general use.

Cultural Successions in British Archæology

BRITISH archæology, perhaps, has profited more than any other field of archæological investigation by the recent diversion of interest from the more striking products of a culture to the building up of a culture complex as a whole. By this means it is now becoming possible to trace in greater detail and with more certainty the racial and cultural successions in Britain, and their interrelations, which went to make up the composite product appearing in these islands on the threshold of historic times. Hence the importance of such sites as Maiden Castle, St. Albans and Wheathampstead, on which more or less continuous or contiguous occupation over a comparatively long period affords an opportunity to follow the changes and modifications brought about by successive cultures.

These great sites, however, are exceptional; but an analogous opportunity, if on a somewhat lesser scale, is afforded for northern England by Eddisbury Hill, the Cheshire hill-fort, of which the recent excavation was described by Mr. W. J. Varley before the Ancient Monuments Society of Manchester on December 6. Here no less than six distinct cultural periods have been observed in the earthwork defences on the crest of the hill. A period of open occupation at the very close of the Bronze Age is represented by burial urns. This was followed by an immigration from the south, which was responsible for the largest hill-fort known in the north of England. An elaborate system of ramparts, ditches and entrances was built up during the first century B.C. This was still further enlarged under the threat of invasion by the Romans. This defensive system exceeds in complexity that of any other known Iron Age hill-fort in Britain. During the Roman occupation the rampart was dismantled and the ditches filled in. The hill lost its defensive character; and in late Roman times there is evidence of the floors of an open site occupation. The last cultural phase is early Saxon, of which relics have been discovered in a hut built over a filled-in ditch between two ramparts. Of traces of the Danish invasion none has hitherto been found; but excavation is not yet complete.

Another instance of a succession of occupations comes from Welwyn, which is all the more significant

in that it lies within the sphere of influence of the Belgic culture, which Dr. R. E. Mortimer Wheeler has described in the St. Albans area. The exploration of the Roman villa which was discovered by accident at Welwyn some five years ago points to the probability that this was a Roman farm; but further investigation shows that it had been preceded by a British, or rather a Belgic, farm.

As was pointed out by Mr. J. Ward Perkins, the excavator, in describing the site before the Society of Antiquaries on December 9, this is the first proved instance of the conversion of a pre-Roman into a Roman farm, although it would not be unreasonable to presume that this had happened with some frequency. The site is also notable for affording the rare evidence of a tower forming part of the Roman building. Such a tower might be presumed to be of frequent occurrence in Roman Britain, although actual traces of an upper story have not often been found. Here the lower part of the tower had walls of flint and brick, with coloured wall-plaster, while the upper part was of timber framing, probably filled with *pisé-de-terre*.

The result of the excavation at Welwyn is especially instructive from more than one point of view. The discovery of a pre-Roman agricultural occupation of the site links up with a number of discoveries of recent years bearing on the social and economic life of the period preceding the Roman invasion. That such discoveries have been made is to be traced in no small part to the efforts and influence of a research committee of the British Association, which directed attention to the significance of apparently unimportant and irrelevant finds on sites in Roman Britain by granting a small subsidy for many years to excavations on such sites in return for reports on the pre-Roman finds, which previously had been neglected. The growth from these small beginnings vindicates the prescience of those by whom the committee was instituted.

Further, and in the same connexion, the Welwyn excavation illustrates the advantages which may accrue from investigating the small and superficially unimportant site.

Science News a Century Ago

Quack Medicine

IN a letter to the *Lancet* of December 23, 1837, "A Constant Reader" writes as follows: "There is a new system adopted by the puffers of nostrums, which, in the country, must operate very injuriously to the public. The other day travelling in the country, I met with a person who, in proof of the good performed by a quack medicine, pulled out of his pocket a handbill in which were stated the *opinions of the leading journals of the metropolis*, of course, highly laudatory of the nostrum in question. The plan formed to deceive the public is as follows:—An advertisement is sent to, perhaps, half a dozen of the leading journals, containing the puff intended to be republished in the handbills of the advertiser. As soon, however, as the advertisement has appeared, it is printed in the handbills, as if coming from the editor of the paper, in which it was inserted as an advertisement, and thus many ignorant persons really believe it to be the opinion of that journal."

Martin Van Marum (1750-1837)

ON December 26, 1837, the death of Martin Van Marum took place at Haarlem. He was born on March 20, 1750, at Groningen, and graduated there in medicine and philosophy. He afterwards practised medicine at Haarlem, but devoted much of his time to lecturing on physical subjects. He made a large number of experiments, especially in electricity, and devised a special form of the plate glass frictional electrical machine, which attracted a good deal of attention.

For more than forty years Van Marum was the secretary of the Dutch Society of Sciences at Haarlem. This Society had been founded in 1752 and was designed to include all branches of science and to further the search for everything necessary for the present and future prosperity of the country, both in its internal and external relations, in peace and war. Its motto was *Deo et Patriæ*. Its first secretary was the preacher Van der Aa, who was succeeded in 1794 by Van Marum, who held office until his death. It was probably through Van Marum that from about 1793 a more predominating place was given to physical science in its proceedings. In 1802 the Society published a volume of *Mechanical and Mathematical Transactions*, and in 1821-22 two volumes of *Philosophical Transactions*. Hooker, Lyell, Owen, Tyndall and Wheatstone were some of the foreign men of science elected to its membership.

The "Göttinger Sieben"

WHEN Queen Victoria came to the throne of England, the crown of Hanover passed to Ernst, Duke of Cumberland, the fifth son of George II. One of his first acts was to suspend the constitution of the State. This act led to a protest by seven professors of the University of Göttingen, who were dismissed then from their posts. They were afterwards referred to as the "Göttinger Sieben". They were Wilhelm Albrecht, professor of law, Friedrich Dahlmann, the historian, Heinrich Ewald, the theologian, Georg Gervinus, Jakob and Wilhelm Grimm, the philologists, and Wilhelm Ed. Weber (1804-1891), the physicist, who, with Gauss in 1833, had set up the first electric telegraph in Germany. As well as being dismissed from their posts, they were banished from the State, but not without meet-

ings of protests from other professors and the students. The streets of Göttingen had to be patrolled by soldiers, and coachmen were forbidden to supply students with carriages to enable them to accompany the professors to the borders.

Extracts from the German papers were given in *The Times* of December 27, 1837, and it is there stated that the students, not to be outdone, walked the sixteen miles to Witzenhausen where, as the exiled professors appeared with their families, they were given a rousing reception. Weber was afterwards professor of physics at Leipzig, but returned to Göttingen in 1849.

An Institution for the Advancement of Science

IN its column of "Weekly Gossip", the *Athenæum* of December 30, 1837, said: "Such of our readers as frequent Regent Street must have observed a large pile of building growing up, of late, on the west side, soon after passing Oxford Street, and communicating with one of the houses in Cavendish Square. This we are informed is about to be opened as an *Institution for the Advancement of the Arts and Practical Science* especially in connexion with Agriculture, Manufactures and other branches of Industry; combining in its results—say the projectors—many of the advantages of the *École Centrale des Arts et Manufactures* in Paris. The house in Cavendish Square will contain a Reading Room, Library and accommodation for the meeting of persons feeling an interest in promoting the objects of the Institution, or desirous of acquiring knowledge of such new discoveries as may, from time to time, be made public. To it will be attached the Gallery, now building, which is to be 127 feet by 40 feet wide and well adapted, we are informed, for the exhibition of novel and useful Models and apparatus illustrative of the various branches of Science and their application to the Arts; with a Laboratory, Experiment Rooms, a Theatre for Lectures, Consultation Rooms for the use of inventors, patentees, persons wishing to make experiments and persons seeking information on any point of science."

University Events

BIRMINGHAM.—The degree of D.Sc. in industrial fermentation has been conferred on J. L. Shimwell for numerous papers, published in the *Journal of the Institution of Brewing*, on bacteriological subjects associated with the brewing and fermentation industry.

CAMBRIDGE.—A grant of £100 a year for five years is recommended to be paid from the Chest to the fund for the upkeep of Wicken Fen.

The degree of Sc.D. has been conferred on W. G. Palmer of St. John's College.

LONDON.—The title of reader in civil engineering in the University has been conferred on Dr. A. L. Higgins in respect of the post held by him at Queen Mary College.

The title of emeritus professor of chemistry in the University has been conferred on Prof. F. G. Donnan on his retirement from the University chair of chemistry at University College.

The degree of D.Sc. in botany has been awarded to Miss Katherine Warrington, of Rothamsted Experimental Station, and that of D.Sc. in physiology to Miss Katherine Tansley, of University College.

Societies and Academies

Dublin

Royal Irish Academy, November 8.

K. G. EMELLÉUS and J. SAYERS: Negative ions in discharge tubes. Rules for the effects of negative ions of molecular dimensions on conductivity and structure in the electric discharge have been formulated. A statistical theory of ion equilibrium in the plasma has been developed, and a source of O⁻ described.

H. SCHMITZ: Irish species of the dipterous family, Phoridae. The paper includes all previous Irish records for the flies of this family and in addition the results of six months (January-June 1937) intensive work at the group by the author and Fr. P. O'Kelly, S.J. Their combined efforts have increased our knowledge of the Irish Phoridae to the extent that there are now records for 117 species where previously we had only ten. Nine species new to science are described and new names proposed for hitherto wrongly identified species, necessary after re-examination of the types of Haliday's species in the National Museum, Dublin.

V. C. A. FERRARO: Functions of quaternions. A function of a quaternion is defined as one which possesses a differential coefficient independent of the differential quaternion. Two cases may be distinguished according as the differential is a pre- or post-factor. The most general type of such a function is arrived at, and suggestions as to other definitions of a function are discussed.

Paris

Academy of Sciences, November 8 (*C.R.*, 205, 825-884).

SERGE BERNSTEIN: The best approximation of non-regular functions.

KENTARO YANO: The equations of geodesics in a variety with projective connexion.

RAPHAËL SALEM: Diophantine approximations and trigonometrical series.

ALFRED LIÉNARD: The generalization of a theorem of Privaloff.

FERNAND AIMOND: The equilibrium of convex surfaces.

RENÉ SWYNGEDAUF: The slipping of a transmission with unequal pulleys.

ÉMILE SEVIN: The action of the sources of stellar energy.

JEAN LOUIS DESTOUCHES: The unity of theoretical physics.

LUCIEN BULL and PIERRE GIRARD: The influence of electric and magnetic fields on the electric spark in air at atmospheric pressure. The effect of an electric field is constant, the spark is always curved with the convexity towards the anode. A magnetic field has generally no effect, but exceptionally one spark in a series shows curvature.

HUBERT FORESTIER and RICHARD LILLE: The influence of magnetic transformations on the velocity of formation of ferrite.

GEORGES DÉCHÈNE: Modifications of the phosphorescence of a semi-conducting zinc sulphide under the influence of an electric current.

MME. MARIE FREYMANN: Comparison of the absorption spectra of the amines in the states of liquid and vapour in the near infra-red.

HORIA HULUBRI: New researches on the element 87 (MI). Discussion of some objections raised to the conclusions on an earlier communication. The lines are admittedly feeble, due to the small proportion of the element present, but the results given in the present paper strengthen the assumption of the existence of the element 87 (moldavium).

WILFRIED HELLER and MME. GERMAINE QUIMPE: The isothermal and reversible variation of the absorption in thixotropic salts.

RENÉ FREYMANN and Jules GUÉRON: Absorption spectra, in the near infra-red, of systems constituted by gaseous hydrochloric acid and an oxygenated organic solvent.

AUGUSTIN BOUTARIC and MME. SUZANNE THÉVENET: Variations of the viscosity of colloidal solutions of arsenic sulphide as a function of the time and under the influence of electrolytes.

MME. RAMART-LUCAS: The structure of coloured substances in the visible part of the spectrum according to their absorption spectrum.

ANTOINE WILLEMART: Researches on the dissociable anthracene oxides: the influence of fatty groups in the meso position.

LOUIS DUNOYER: Optical illusions produced by a rotating light (in a lighthouse).

EDMOND ROTHÉ and ELIE PETERSCHMITT: The mode of production of earthquakes. The distribution of compressions and expansions.

PIERRE LESAGE: The exchange of the seeds of *Lepidium sativum* between media at different temperatures. Studies on the duration of acquired precocity in plants grown in different climates.

PAUL BERTRAND: Remarks on the comparative ontogeny of living and fossil phanerogams. The correct interpretation of the organization of seedlings of phanerogams gives a means of reconstituting with sufficient accuracy the organization of seedlings of all fossil phanerogams, provided that there is a good transverse section of the stem and some indications on the structure of the root.

LOUIS BLARINGHEM: Remarks on the preceding communication.

JEAN BEAUVÉRIE: The granular structure of the chloroplasts: the stroma.

MME. LISE EMERIQUE: Experimental rickets in the guinea pig.

ANDRÉ LWOFF and HISATAKE DUSI: Thiazol, a growth factor for *Polytoma ocellatum*. The importance of the constituents of aureine for the leucophyte flagellates.

Amsterdam

Royal Academy (*Proc.*, 40, No. 8, October 1937).

F. A. VENING MEINESZ: (1) Second order disturbance terms in pendulum observations at sea. A discussion of Browne's correction terms and their possible experimental determination. (2) Determination of the earth's plasticity from the post-glacial uplift of Scandinavia: isostatic adjustment.

J. CLAY and G. VAN KLEEF: Conductivity of pure gases at high pressures. Neon and xenon become conducting even in the absence of an external ionizing agent at certain pressures between 60 and 80 atm.

J. G. VAN DER CORPUT: Weyl's method in the theory of numbers.

R. WEITZENBÖCK: Trivectors.

E. COHEN and W. A. T. COHEN-DE MEESTER: Daniel Gabriel Fahrenheit (2). A further contribution to the history of Fahrenheit.

H. BREMEKAMP: Carson's integral equation.
HWA-CHUNG LEE: Differential geometry of contact transformations.

J. HAANTJES: Conformal representations of an n -dimensional Euclidean space with a non-definite fundamental form on itself.

J. M. VAN DER ZANDEN: Polymerides of methylchavicol.

A. W. H. VAN HERK: Chemical processes in the spadix of *Sauromatum* (3).

H. W. V. WILLEMS: Relation between the optical properties and the chemical composition of glaucophane.

G. C. HIRSCH: Outlines of a theory of the Golgi bodies (2). The Golgi bodies in time.

G. STIASNY: *Parerythropodium maris-tenebrosi* n.sp., a new alcyonarian from the coast of north-west Africa.

Vienna

Academy of Sciences, October 21.

H. BENNDORF and MELITTA MITLACHER: Stationary air currents in closed vessels. It is found that the needle of a short-circuited electrometer moves with a period of one day. On certain days, a short-period motion is superposed on the diurnal motion. The short-period motion is due to fluctuations in the barometric pressure causing air to stream in and out of the case, while the diurnal motion is due to small temperature changes in the case of the electrometer setting up slowly varying, quasi-stationary air currents. The diurnal variation of these air currents may give rise to errors in large ionization chambers.

G. STETTER and F. PRANKL: Resonance effect in the disintegration of aluminium by α -rays.

K. JEZEK: Stress in a lap weld with chamfered seam.

F. WESSELY, A. MÜNSTER and S. WANG: Catalytic hydrogenation of saturated lactones.

October 28.

W. J. MÜLLER and R. GRUBER: Comparative study of the reactivity of lignites and their cokes. The results given by different methods of measurement are compared.

E. BARONI and A. FINK: Concentration of D_2O in natural ice (4).

K. BRAUNER: Curvature property of manifolds of class 1.

F. WERNER: Fauna of the Peloponnesus, the islands of Cythera and Euboea and the islets of the Saronic Gulf.

K. ZALESKY: Mammals of Lower Austria, with particular reference to the Gölsental.

November 4.

R. INZINGER: Curve invariants of cyclic series.
S. MEYER: Age of the sun and the decay constant of actino-uranium.

E. CLAR: Stratigraphy of the Schwarzeck breccia in the Radstädter Tauern.

H. STROUHAL: Greek millipeds collected by Dr. F. Werner in 1937.

J. SCHNEIDER: Discovery of a female Boii skeleton at Vill near Innsbruck.

A. ERDÉLYI: Non-uniform strings with a parabolic distribution of density.

L. LÄMMERMAYER: Amount and nature of the growth of wood at and above the forest boundary.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR ASSISTANT CHEMIST (male) at the Royal Ordnance Factory, Irvine—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (January 3) (Quote Appts./60).

TECHNICAL OFFICER (radio development) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (January 8) (Ref. No. 526).

ONE BACTERIOLOGIST AND ONE NATURALIST in the Laboratories of the Freshwater Biological Association of the British Empire at Wray Castle, Ambleside, Westmorland—The Director (January 31).

LIVESTOCK PROFESSOR OF COAL GAS AND FUEL INDUSTRIES in the University of Leeds—The Registrar (February 5).

ASSISTANT LECTURER in HORTICULTURE in Buckinghamshire—The Agricultural Organizer, County Offices, Aylesbury.

Official Publications Received

Great Britain and Ireland

Forestry Commission. Report of the National Forest Park Committee (Snowdonia), 1937. Pp. 5+1 plate. (London: H.M. Stationery Office.) 6d. net. [1911]

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1936; with Report and Notes of the Director. Pp. xx+40. (Blackburn: Stonyhurst College Observatory.) [1911]

Technical Publications of the International Tin Research and Development Council. Series A, No. 66: Measurement of the Thickness of Tin Coatings on Steel by a Magnetic and Electromagnetic Method. By Dr. B. Chalmers, W. E. Hoare and W. H. Tait. Pp. 9. Free. Series B, No. 6: The Wetting of Metals by Metals with particular reference to Tinning and Soldering. By E. J. Daniels and D. J. Macnaughtan. Pp. 11. Free. (London: International Tin Research and Development Council.) [1911]

Report by the Food Council to the President of the Board of Trade on Costs and Profits of Retail Milk Distribution in Great Britain. Pp. 36. (London: H.M. Stationery Office.) 9d. net. [1911]

Royal Commission on Awards to Inventors. Final Report. (Cmd. 5594.) Pp. 8. (London: H.M. Stationery Office.) 2d. net. [1911]

University of London: University College. Calendar, Session 1937-1938. Pp. lxxx+14+580+24. (London: Taylor and Francis, Ltd.) [1911]

Other Countries

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 89. Studies on the Family Acrididae (Orthoptera) of Venezuela. By H. Radcliffe Roberts. Pp. 343-368. Zoological Results of the George Vanderbilt African Expedition of 1934. Part 8: Lepidoptera; Rhopalocera. By E. T. Cresson, Jr. Pp. 369-384. Third Preliminary Report on the Results of the Second Dolan Expedition to West China and Tibet; Four New Birds from Tibet. By Ernest Schäfer. Pp. 385-386. (Philadelphia: Academy of Natural Sciences.) [1911]

Union of South Africa: Department of Mines: Geological Survey. Memoir No. 33: The Geology of the Country around Bethlehem and Kretzill; with Special Reference to Oil Indications. By O. R. Van Eeden. Pp. 60. (Pretoria: Government Printer.) 7s. 6d., including Map. [1911]

The University and the National Life: Three Addresses to Victorian Political Organizations. By Dr. R. E. Priestley. Pp. 48+9 plates. (Melbourne: Melbourne University Press.) [1911]

Annals of the Royal Botanic Garden, Calcutta. Vol. 14, Part 1: An Account of the Genus *Dioscorea* in the East. Part 1: The Species which Twine to the Left. By D. Prain and I. H. Burkill. Pp. 210+vi+85 plates. (Calcutta: Government Printing Office.) 75 rupees; £5 13s. 6d. [1911]

Smithsonian Miscellaneous Collections. Vol. 96, No. 6: Growth of *Avena* Coleoptile and first Internode in Different Wave-length Bands of the Visible Spectrum. By Earl S. Johnston. (Publication 3444.) Pp. 19. (Washington, D.C.: Government Printing Office.) [1911]

Catalogues, etc.

Klassische Philologie, Teil 1. (Antiquariatskatalog Nr. 716.) Pp. 240. Geschenkwerke aus allen Gebieten der Unterhaltung und des Wissens. (Bücher-Anzeiger No. 170.) Pp. 150. Mittelalter: Geschichte, Kulturgeschichte, Rechts- und Wirtschaftsgeschichte, Kirchengeschichte. (Antiquariatskatalog Nr. 718.) Pp. 272. (Leipzig: Gustav Fock, G.m.b.H.)

Catalogus Dissertationum, Philologicarum Classicarum. Editio III. Erläuterungsschriften zu den griechischen und lateinischen Schriftstellern, enthaltend die Literatur aus den Jahren 1911-1936. Pp. 176. (Leipzig: Gustav Fock, G.m.b.H.) 1.50 gold marks.

Dulau's Autumn 1937 Botanical Catalogue, with a few Miscellaneous Natural History Books in addition. (No. 266.) Pp. 46. (London: Dulau and Co., Ltd.)

A Short Catalogue of Books relating to Africa. (Catalogue N.S. No. 25.) Pp. 28. Books of Early Science, Medicine, etc. (Catalogue N.S. No. 26.) Pp. 42. Dawson's Periodica (English and Foreign). (Catalogue N.S. No. 27.) Pp. 56. (London: Wm. Dawson and Sons, Ltd.)

English Books before 1700. (Catalogue No. 619.) Pp. 72. (London: Francis Edwards, Ltd.)

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